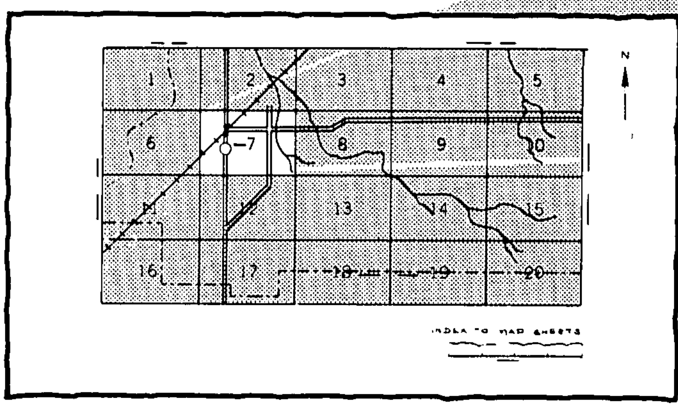
SOIL SURVEY OF

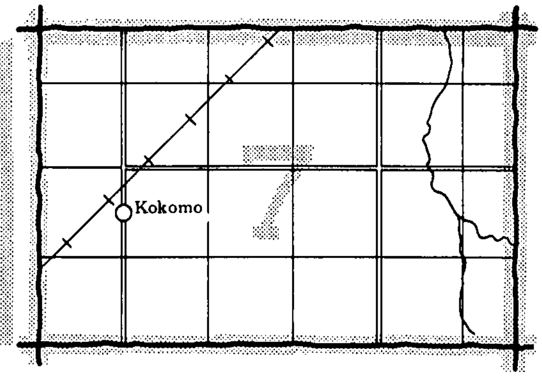
Clay County, Nebraska

United States Department of Agriculture
Soil Conservation Service
In cooperation with
University of Nebraska, Conservation and Survey Division

HOW TO USE

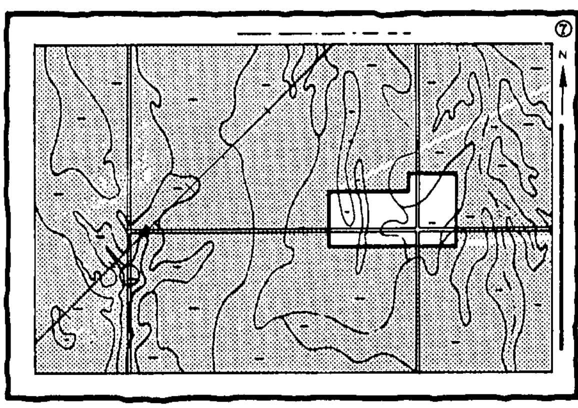
1. Locate your area of interest on the ''Index to Map Sheets''

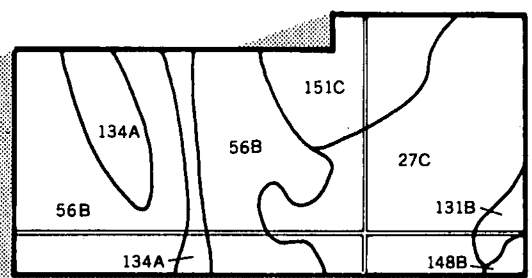




2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





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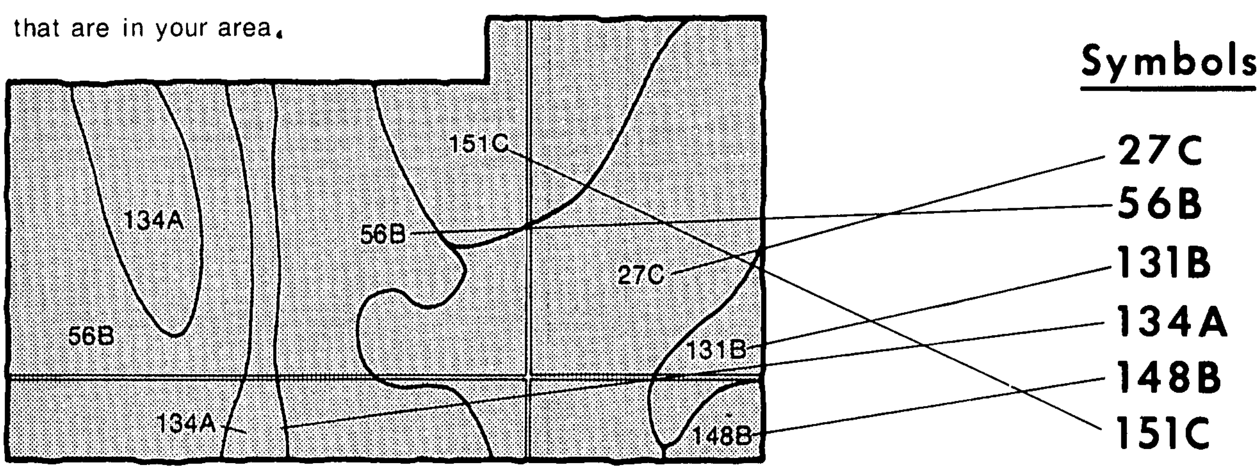
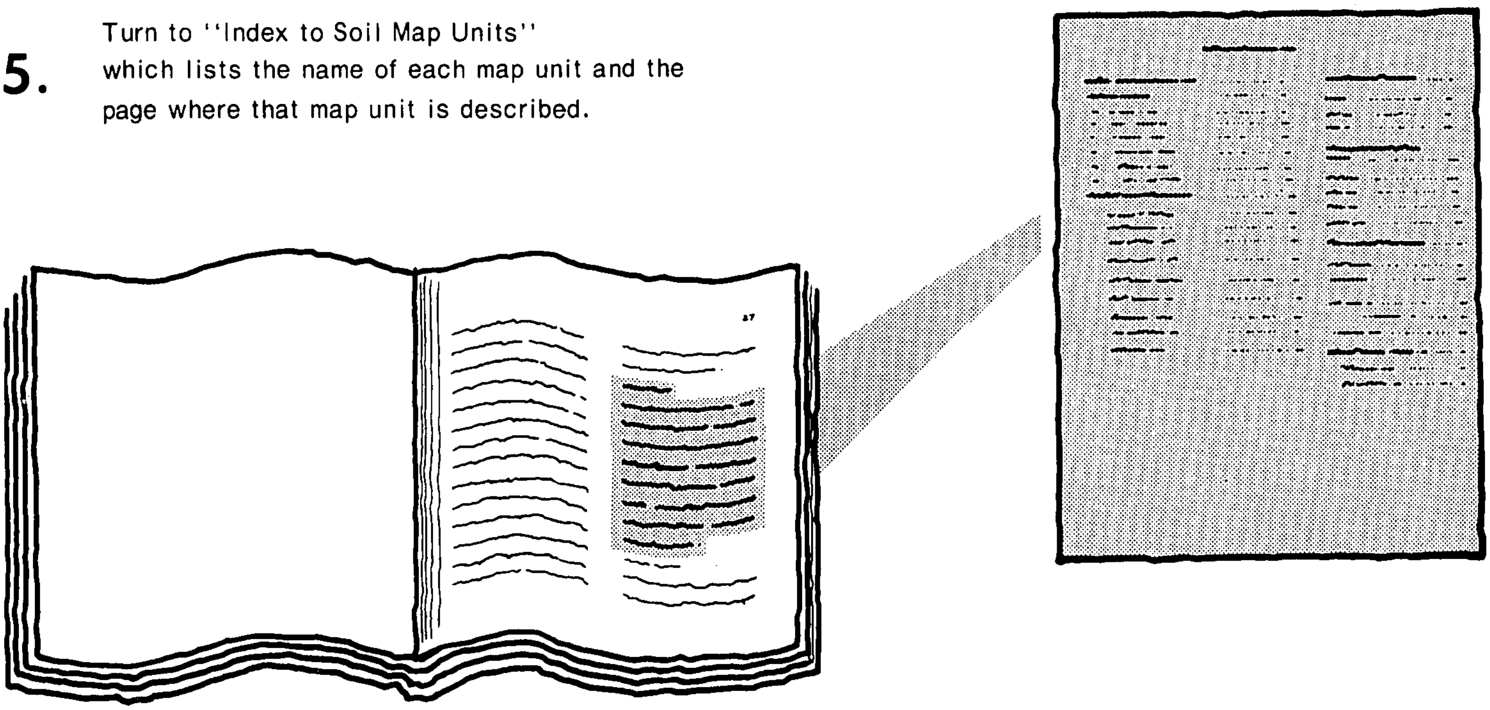
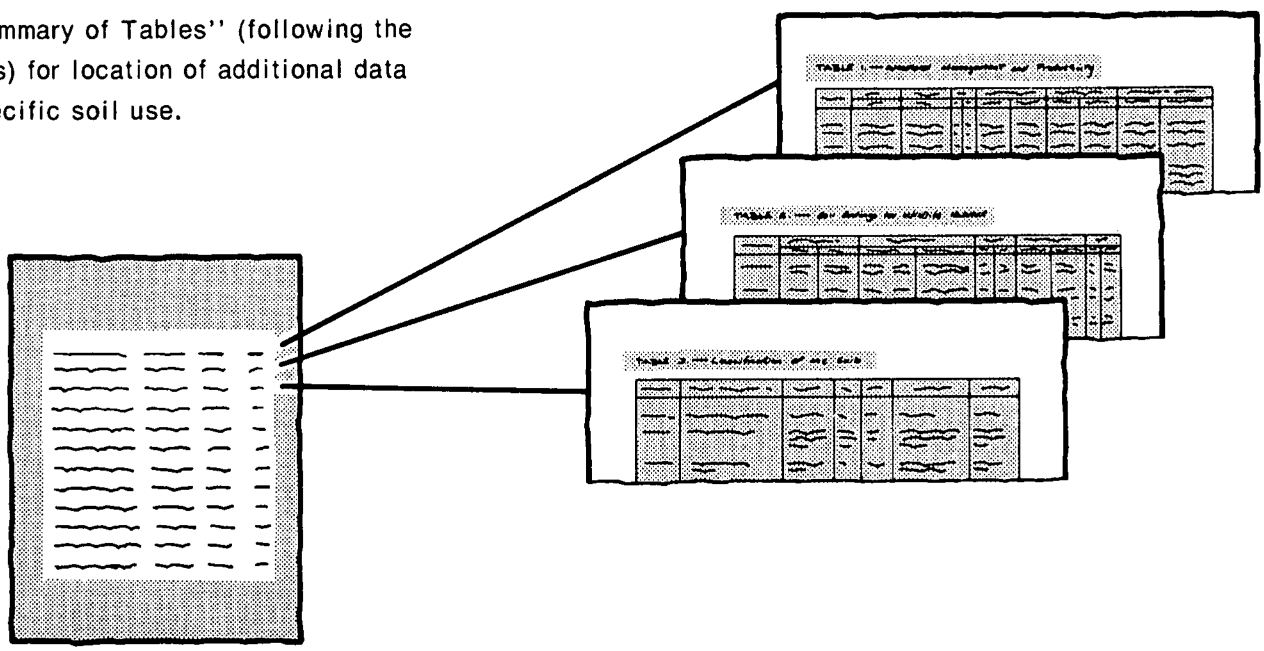


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. The University of Nebraska Institute of Agricultural and Natural Resources, Conservation and Survey Division, has leadership for the state part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1974-78. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the Upper Big Blue and Little Blue Natural Resource Districts and the Clay County Commissioners. These local agencies made financial contributions for this survey.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Conservation practices used on Hastings-Crete-Butler association are irrigation water management, farmstead windbreaks, terraces, contour farming, grassed waterways, and range seeding.

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foreword

This soil survey contains information that can be used in land-planning programs in Clay County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Benny Martin

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State Conservationist
Soil Conservation Service

soil survey of
Clay County, Nebraska

By Roger R. Hammer and Larry G. Ragon, Soil Conservation Service
and Arthur A. Buechle, University of Nebraska
Conservation and Survey Division

United States Department of Agriculture, Soil Conservation Service
in cooperation with
University of Nebraska, Conservation and Survey Division

Clay County is in the south-central part of Nebraska (fig. 1). It has a total area of 570 square miles or 364,800 acres. Clay Center, the county seat, is in the center of the county.

Clay County is in the Central Loess Plains part of the Great Plains. This nearly level and gently undulating upland plain slopes generally to the southeast and east and is dissected by streams that flow in the same general direction. In the northern part is the West Fork of the Big Blue River and School Creek. In the southwestern part is the Little Blue River. In the central and southeastern parts are Little Sandy Creek and Big Sandy Creek, and in the east-central part is Turkey Creek. Rolling and steep loess hills and nearly level bottom lands and stream terraces are along most of these streams. Many shallow basins and depressions on uplands hold water.

Most of the land is used for farming. Farms are generally combination cash-grain and livestock operations. About 81 percent of the county is used as cropland. Of this, about 58 percent is irrigated mainly from deep wells. About 12 percent of the county is used as rangeland, and about 1 percent is planted to windbreaks and trees. Nearly all of the soils in Clay County have a silty surface layer and a dominantly silty or clayey subsoil.

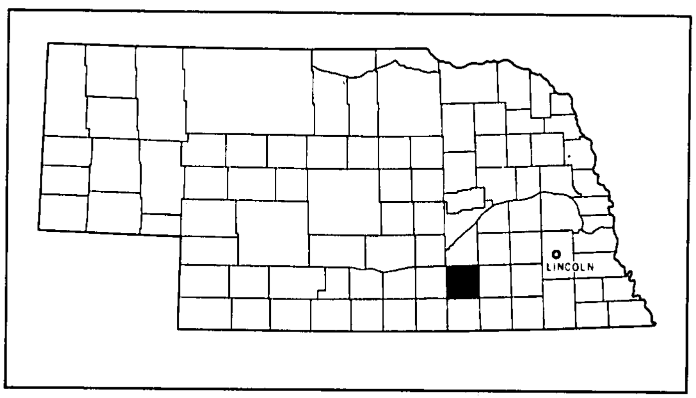

Figure 1.—Location of Clay County in Nebraska.

The native grass area of Clay County is mainly used as rangeland. A large area of native grass is in the Meat Animal Research Center in the west-central part of the county. Smaller areas that are steeply sloping, frequently flooded, or sloping uplands adjacent to wetland basins are also used as rangeland. Marsh vegetation is on parts of the wettest basins. Many of the basins and some of the adjacent uplands are in National Wildlife Management areas. Trees are along the main streams and along the edges of the wetland basins.

The first soil survey of Clay County was published in 1927 (*9*). This new survey updates the previous one on soil interpretations and soil classification and provides additional information and larger maps that show the soils in greater detail.

general nature of the county

This section provides general information concerning Clay County. It discusses history and development; physiography, relief, and drainage; geology; climate; and water supply.

history and development

The Pawnee Indians were the first known inhabitants of what is now known as Clay County, Nebraska (*3*). The earliest travelers to enter Clay County were fur trappers. These trappers and hunters did not establish residency. Settlers on the Oregon Trail crossed the southwestern corner of Clay County from southeast to northwest as early as the 1830's. Today, markers indicate this historic trail and others, such as the Fort Riley and Fort Kearney Trails and the Pony Express Route. Spring Ranch, located along the Little Blue River, was a stop for stagecoaches as early as 1850.

The first permanent settlement in the area was in 1857 on the Little Blue River at Pawnee Ranch in the southwestern part of the county. In Sutton, a monument was erected to the memory of Luther French. This is the site of the first dug-out home in the area. Clay County was established on February 16, 1867 and was organized under proclamation of action by Governor James, September 11, 1871. Sutton was platted and became the first county seat in 1871. In 1879 the county seat was moved to Clay Center.

With the westward movement of railroads came the establishment of towns. The towns of Sutton, Saronville, Harvard, Inland, Trumbull, Clay Center, Ong, and Deweese were established along the railroad. The towns of Edgar, Fairfield, and Glenvil were also established along the railroad. The first settlement under the Timber Claim Act of the United States was a farm identified as the northeast quarter of sec. 32, T. 5 N., R. 6 W., in Clay County. A stone from the old Nebraska Capitol Building marks the site. The claim was registered and granted on March 30, 1883.

Most of Clay County was homesteaded by 1880. Despite blizzards, hailstorms, prairie fires, and grasshoppers, the 1880's showed great promise. The drought and grasshopper plagues of the 1890's reversed this trend until the 1900's. The population of Clay County in 1870 was 54. In 1910 it reached its maximum at about 15,700. It has steadily declined since that time and was 8,717 in 1960 and 8,266 in 1970.

The Dust Bowl Days and Depression of the 1930's forced many farms and businesses to be abandoned. The Naval Ammunition Depot and the Harvard Air Bases were formed during World War II. Some of the depot area became the United States Meat Animal Research Center in 1969. Some of the land was sold to the city of Hastings for commercial development. Some was transferred to other military and government branches or sold to individuals.

After the Dust Bowl Days of the 1930's, there was an interest in soil and water conservation in the county. The Clay County Soil Conservation District was formed in 1947 and completed 25 years of operation before the formation of the Little Blue and Upper Big Blue Natural Resource Districts.

Farming has been and still is the major occupation in Clay County. Since the dry period of 1955, deep well irrigation has increased at a rapid rate. In 1946 there were 50 irrigation wells. Today there are well over 1,500. Increased crop production as a result of irrigation and modern methods of farming have brought about the need for grain elevators. Almost every town has at least one grain elevator to market grain. The grain is transported to larger markets by rail or truck.

Good transportation facilities have developed over the years in Clay County. U.S. Highways 6 (east and west) and 14 (north and south) are the major highways. State Highways 41 and 74 run east and west. Hard surfaced roads to most towns are maintained by the state. Most of the other roads are gravelled. Rural mail service and school bus service are provided to all parts of the county.

Railroads provide main or branch lines to most towns in the county. A nationwide truck line has a terminal in Clay Center. Several other truck lines serve the area. Bus service is available in the towns on major highways. There are private airstrips in the Harvard State Airfield in the county, but the nearest municipal airport is in Hastings in Adams County.

Livestock auctions are held each week in Sutton and also in Blue Hill, Grand Island, York, and Superior in adjoining counties. Livestock that is not sold locally is generally trucked to larger markets. Most of the poultry and dairy products are marketed locally.

physiography, relief, and drainage

Clay County is within the Central Loess Plains, which is part of the Great Plains physiographic province. The general physiography of the county is that of nearly level and gently undulating southeastward sloping plains, which are dissected by streams and modified by mostly small depressions. The Little Blue River is the most deeply entrenched stream in the county. Most of the bottom lands and stream terraces are very narrow, except along the Little Blue River.

The Little Blue River and its tributaries dissect the southwestern part of the county. The river valley averages about 1 mile wide, and the floor of the river is 100 to 200 feet below the uplands. Major tributaries of the Little Blue River are Pawnee Creek, Buffalo Creek, Oak Creek, and Dry Creek.

The West Fork of the Big Blue River and its tributaries dissect the northwestern part of the county. The river valley is less than one-half mile wide, and the floor of the river is 40 to 60 feet below the uplands. A few of the tributaries flow northward out of the northwestern part of the county where they join in Hamilton County.

Other major drainageways flow from the central to the eastern and southeastern parts of the county. School Creek begins northwest of Clay Center, flows east through Sutton, and into Fillmore County. Little Sandy Creek begins west of Clay Center and flows southeastwardly by Clay Center to south of Ong and into Fillmore County. Big Sandy Creek enters the west-central part of Clay County from Adams County, flows southeastwardly toward Edgar, and into Nuckolls County. It is the longest stream in Clay County. Turkey Creek begins in the east-central part of Clay County and flows east into Fillmore County.

The rest of Clay County is nearly level to very gently sloping uplands that are dissected by more sloping, small drainageways, some of which flow into basins or depressions. Water ponds in these undrained areas for brief to very long periods of time. Most of these depressions are oriented northeast to southwest. A more undulating topography accompanies these depressions in the southeastern part of Clay County.

The average elevation of the county is about 1,750 feet above sea level. Elevation ranges from 1,882 feet northwest of Trumbull to 1,678 feet at Sutton to the east and 1,680 feet at Ong to the southeast. Elevation on the Little Blue River ranges from about 1,750 feet on its western boundary to about 1,650 feet on its southern boundary. Harvard is 1,801 feet, Clay Center is 1,781 feet, Fairfield is 1,779 feet, and Edgar is 1,724 feet above sea level.

geology

Clay County is underlain to a depth of 100 to 400 feet by unconsolidated deposits of Quaternary age (*4, 5*). These deposits cover a relatively uneven bedrock surface consisting of Cretaceous age rocks. In one small area at the northwest corner of the County, less than 2 square miles, a thin remnant of Tertiary age rock, Ogallala Formation, overlies the Cretaceous rock (*6, 7*).

The Quaternary deposits consist of loess and water-deposited sediments. Loess is a silty, wind deposited material. It covers nearly all of the uplands, including the side slopes of upland drainageways. Depressions and drainageways on uplands are floored with water-transported materials derived from adjacent slopes.

The Little Blue River has cut its valley into the underlying, clayey to gravelly, water-deposited sediments. These sediments are at the surface on some valley side slopes, principally on the north side of the river. The valleys of Big Sandy Creek, School Creek, and the West Fork of the Big Blue River are cut into the underlying sediments, in places; however, the sediments are on the surface of only a few sites. Stream terrace deposits and alluvium in these valleys were derived partly from loess and partly from the underlying sediments that were exposed and eroded as the valleys were cut.

Alluvium of recent age along these streams is derived largely from loess and locally includes sand washed from valley side slopes. In the flood plain of the Little Blue River, materials from upstream sources make up a considerable part of the alluvium and are similar to the locally derived materials.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

In Clay County, winters are cold because of incursions of cold, continental air that bring fairly frequent spells of low temperature. Summers are hot with occasional interruptions of cooler air from the north. Snowfall is fairly frequent in winter, but snow cover is usually not continuous. Rainfall is heaviest late in spring and early in summer. Annual precipitation is normally adequate for wheat, sorghum, and range grasses.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Clay Center in the period 1951 to 1973. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 27 degrees F, and the average daily minimum temperature is 15 degrees. The lowest temperature on record, which occurred at Clay Center on January 6, 1971, is −19 degrees. In summer the average temperature is 75 degrees, and the average daily maximum temperature is 88 degrees. The highest recorded temperature, which occurred on July 11, 1954, is 109 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 27.5 inches. Of this, 21 inches, or 80 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 4.1 inches at Clay Center on May 21, 1961. Thunderstorms occur on about 50 days each year, and most occur in summer.

Average seasonal snowfall is 34 inches. The greatest snow depth at any one time during the period of record was 35 inches. On an average of 29 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 14 miles per hour, in April.

Severe duststorms occasionally occur in spring when strong dry winds blow over unprotected soils. Tornadoes and severe thunderstorms, sometimes with hail, occasionally occur. These storms are local and of short duration, and the pattern of damage is variable and spotty.

water supply

The main source of water for irrigation and for municipal, domestic, livestock, and industrial uses in Clay County is ground water (*8*). Most of the ground water used is pumped from water-saturated sand and gravel deposits of Pleistocene age. These deposits average from 50 to 150 feet in thickness throughout most of the county, and wells in these areas can yield more than 1,000 gallons per minute. Areas that have less than 50 feet of saturated sand and gravel are east of Clay Center to the Clay-Fillmore County line, north and northeast of Trumbull, north of Sutton, and south of the Little Blue River. Yields from wells in these areas are much less; in a few areas, water for domestic and livestock purposes is limited.

Depth to the water table ranges from 60 to 100 feet throughout the county. Along the Clay-Adams County line, there is an area in which the water table is at a depth of 100 to 150 feet and other similar areas north of Fairfield and southeast of Clay Center. Along creeks and rivers, the water table is at a depth of less than 60 feet. It is commonly at a depth of less than 20 feet on the Little Blue River bottom lands, and yields from wells are less than 500 gallons per minute.

Most of the water pumped from the ground is used to irrigate field crops. The amount pumped varies from year to year depending on the amount of precipitation received. Water use has increased so much that in certain areas the amount of discharge exceeds the amount of recharge to the ground water. Recharge is principally from precipitation, but much water is lost through evaporation, transpiration by plants, and surface runoff. Water that is collected in basins contributes very little by seepage to the water table.

Depressions are underlain by slowly permeable clayey materials, and ponded water is chiefly lost through evaporation and transpiration. These depressions supply water for wildlife and aquatic vegetation. Streams whose beds are above the water table seep water to the ground water during streamflow. Seepage of the water applied to irrigated lands contributes to ground water recharge, but good irrigation management practices minimize the loss of water to recharge.

Good quality ground water is available throughout Clay County. It is moderately mineralized and is rated hard and very hard. The hardness is not a health hazard to people or livestock and causes no problems if it is used for irrigating farm crops. The hardness can be reduced, if desired, for domestic and industrial uses.

The Little Blue River and the West Fork of the Big Blue River are the only perennial streams that provide water for irrigation, livestock, and recreation. Many tailwater recovery pits and dugouts provide open water areas for migratory wildlife in fall and spring. Many small and a few large dams provide water for livestock, wildlife, and recreation.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit, or association, on the general soil map is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other associations but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

well drained to somewhat poorly drained soils on uplands

The association in this group makes up about 57 percent of the county. The soils are nearly level to gently sloping. Most of the acreage of this association is cultivated except for a large area of native and introduced grasses in the Roman L. Hruska, United States Department of Agriculture, Meat Animal Research Center. Also, small grassed areas are near wetlands and farmsteads.

Most of the acreage is irrigated by the gravity system and the center-pivot sprinkler system. Dryland crops are grown where no wells exist or where wells have poor yields. Soil blowing and water erosion are the main hazards. Low moisture supply to plants and wetness are the major limitations. Conserving irrigation water and soil moisture for plants are the main concerns of management.

1. Hastings-Crete-Butler association

Deep, nearly level to gently sloping, silty soils and deep, nearly level and very gently sloping, silty soils that have a claypan subsoil on loess uplands

This association consists mainly of broad, flat and gently undulating divides with many slightly concave areas and some narrow drainageways. Soils on the divides are mostly nearly level and very gently sloping, but some are gently sloping. Soils in the concave areas are nearly level. Soils on the sides of drainageways are mostly gently sloping, but some are very gently sloping.

This association makes up 209,015 acres or about 57 percent of the county. It is about 62 percent Hastings soils, 18 percent Crete soils, 10 percent Butler soils, and 10 percent soils of minor extent (fig. 2).

Hastings soils are mostly on broad, nearly level or very gently sloping divides. Some of these soils are on gently sloping ridges of divides, and are on very gently sloping or gently sloping sides of narrow drainageways. These soils are well drained and have a dark grayish brown silt loam surface layer. In eroded areas, the surface layer is grayish brown silty clay loam. The subsoil is dark grayish brown, brown, and pale brown silty clay loam. The underlying material is pale brown silt loam.

Crete soils are mostly on very gently sloping or nearly level divides. Some of these soils are on very gently sloping sides of drainageways. These soils are moderately well drained and have a grayish brown silt loam surface layer. The subsoil is mainly grayish brown silty clay. The underlying material is light gray silt loam.

The Butler soils are in the nearly level and slightly concave areas. Most of these soils are at the heads of drainageways. These soils are somewhat poorly drained and have a grayish brown silt loam surface layer and a gray silt loam subsurface layer. The subsoil is mainly very dark gray and dark grayish brown silty clay. The underlying material is grayish brown and light brownish gray silt loam.

Of minor extent are the Fillmore, Holder, Scott, Hobbs, Uly, and Massie soils. Fillmore, Scott, and Massie soils are in depressions or basins. Holder soils are on the gently sloping and strongly sloping sides of drainageways. Hobbs soils are on the narrow bottoms of drainageways. Uly soils are on the moderately steep and steep sides of drainageways.

Farms in this association are diversified and are mainly the combination cash-grain and livestock type. They average about 480 acres. The soils are mainly used for irrigated crops, such as corn. The sloping soils on the sides of drainageways are mainly used for dryland crops, such as grain sorghum and wheat. East of Clay Center, a narrow area extends along the north side and, further down, on both sides of Nebraska Highway 41 to the Fillmore County line. In this area, the potential for irrigation is poor because most wells have poor yields. Most of the very gently sloping Crete soils are in this

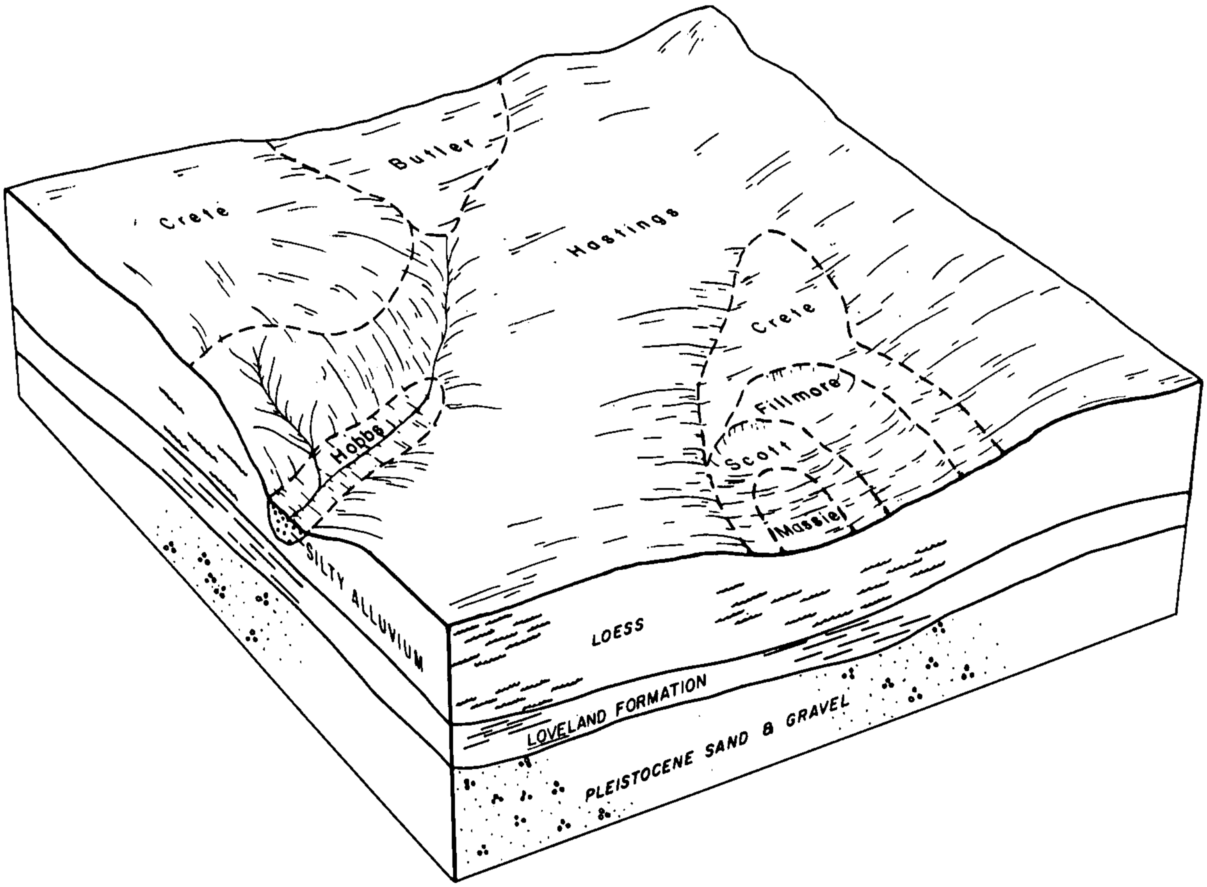

Figure 2.—Typical pattern of soils in the Hastings-Crete-Butler association showing the relationship of the soils to topography and parent materials.

area. Other much smaller areas similar to this one are north of Sutton and around Trumbull. Mostly dryland crops are grown in these areas.

Areas of rangeland and pasture are small and are mainly on the Fillmore and Scott soils and soils along narrow drainageways. A large area, however, is in the Roman L. Hruska, United States Department of Agriculture, Meat Animal Research Center. This area makes up about 10 percent of this association. Besides the large livestock operation in this area, some livestock are fattened in feedlots or raised for breeding stock on farms. The Massie soils are mainly used as habitat for wetland wildlife, and some areas are part of the National Wildlife Management Areas.

Soil blowing is a minor hazard on the nearly level cultivated soils, and water erosion is the main hazard on the more sloping cultivated soils. Conserving soil moisture is a concern if these soils are cultivated. On the claypan soils, low moisture supply to plants is a limitation during periods of drought. Wetness is a limitation during wet seasons. Fillmore, Scott, and Massie soils are ponded for brief to very long periods from about March to about August. In wet years, Massie soils and some areas of Scott soils may be ponded throughout the year. Management of irrigation water is important on irrigated land.

Gravel or improved dirt roads are on most section lines except in the Meat Animal Research Center and some of the large basins. Paved highways cross most of this association. Grain, livestock, and other farm products are marketed mainly within the county or in adjacent counties.

moderately well drained and well drained soils on uplands

The association in this group makes up about 19 percent of the county. The soils are nearly level and very gently sloping. Most of the acreage of this association is cultivated except for a large area of introduced and native grasses in the Roman L. Hruska, United States Department of Agriculture Meat Animal Research Center. Some small grassed areas are near wetlands and farmsteads.

Most of the acreage is irrigated by the gravity system and the center-pivot sprinkler system. Soil blowing is the main hazard. Conserving irrigation water and soil moisture for plants are the main concerns of management.

2. Crete-Hastings association

Deep, nearly level and very gently sloping, silty soils that have a claypan subsoil and deep, nearly level to gently sloping, silty soils on loess uplands

This association consists mainly of broad divides with some depressions and a few narrow drainageways. Soils on the divides are nearly level and very gently sloping, and those on the sides of drainageways are very gently sloping and gently sloping.

This association makes up 67,530 acres or about 19 percent of the county. It is about 80 percent Crete soils, 7 percent Hastings soils, and 13 percent soils of minor extent (fig. 3).

The Crete soils are mostly on the broad, nearly level divides. A few areas of these soils are on the very gently sloping sides of narrow drainageways. These soils are moderately well drained and have a gray and dark gray silt loam surface layer. The subsoil is dark grayish brown and brown silty clay. The underlying material is pale brown silt loam.

The Hastings soils are on the narrow, nearly level and very gently sloping divides, and the very gently sloping and gently sloping sides of narrow drainageways. These soils are well drained and have a dark grayish brown silt loam surface layer. The subsoil is dark grayish brown,

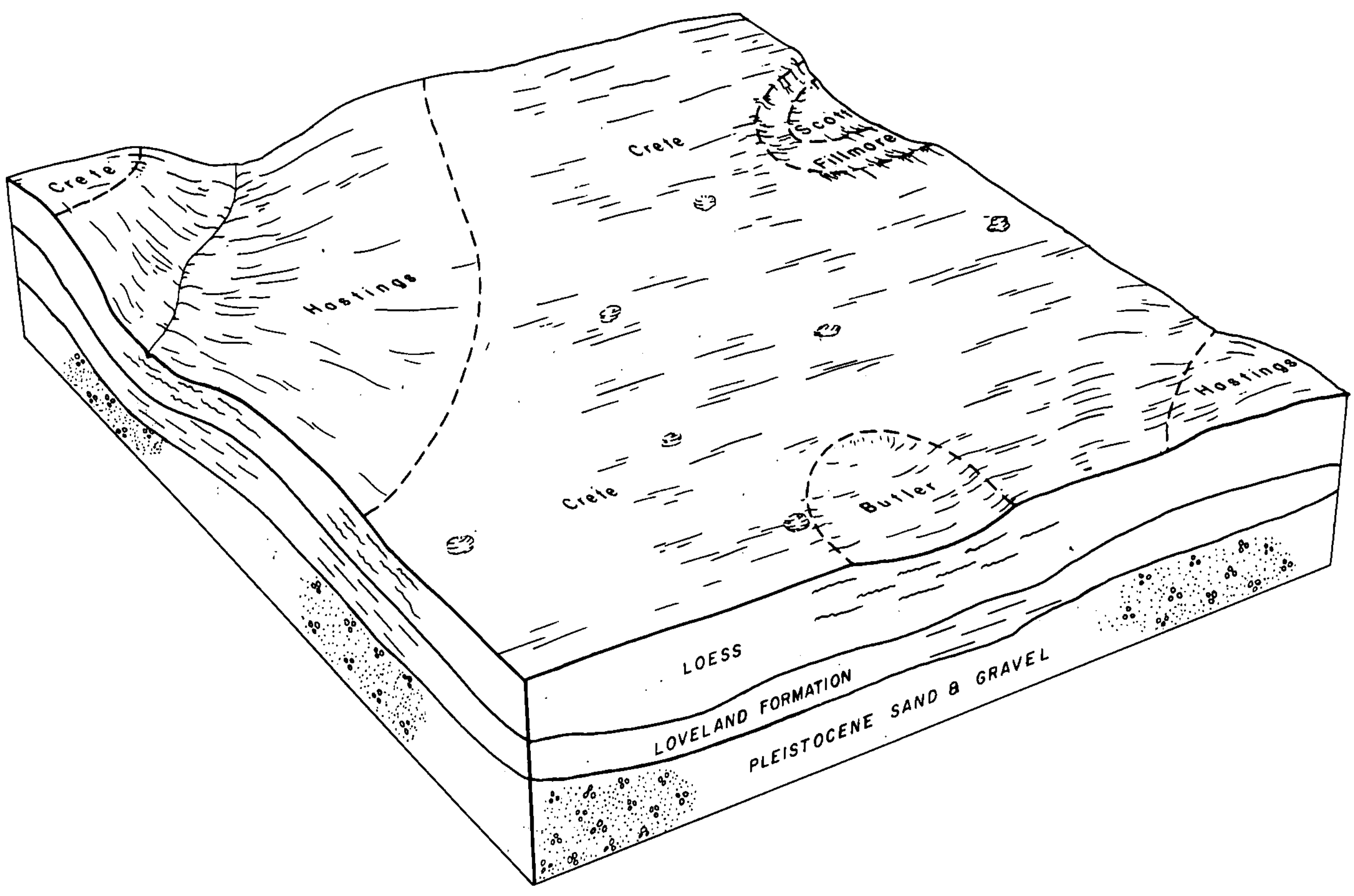

Figure 3.—Typical pattern of soils in the Crete-Hastings association showing the relationship of the soils to topography and parent materials.

brown, and pale brown silty clay loam. The underlying material is pale brown silt loam.

Of minor extent are the Butler, Fillmore, and Scott soils. The Butler soils are nearly level and are on slightly concave areas of divides. Fillmore and Scott soils are in depressions.

Farms in this association are mainly the cash-grain type. Some farms are the combination cash-grain and livestock type. They average about 320 acres. The nearly level to gently sloping soils are mainly used for irrigated crops. The soils on the sides of drainageways are mainly used for dryland crops, such as grain sorghum and wheat. About 35 percent of this association is within the Roman L. Hruska, United States Department of Agriculture Meat Animal Research Center, most of which is rangeland and pasture. Some of the acreage is used for irrigated corn and alfalfa. Besides the large livestock operation at the Research Center, some livestock are fattened in feedlots on a few farms.

On the claypan soils, low moisture supply to plants is a limitation during periods of drought. Wetness may be a limitation during wet seasons. Soil blowing is a minor hazard on the nearly level cultivated soils, and water erosion is a moderate hazard on the more sloping cultivated soils. Conserving soil moisture is a concern if these soils are cultivated. Management of irrigation water is important on irrigated land.

Gravel or improved dirt roads are on most section lines except in the Meat Animal Research Center. Paved highways cross most of this association. Grain, livestock, and other farm products are marketed mainly in the county and at markets in adjacent counties.

well drained and very poorly drained soils on uplands

The association in this group makes up about 7 percent of the county. The soils are nearly level to gently sloping. Most of the acreage of this association is cultivated except for areas of wetland vegetation and native and introduced grasses in and around wetlands.

A large part of the cultivated land is irrigated mainly by center-pivot sprinklers. The rest is in dryland crops. Water erosion and ponding of water are the main hazards. Planning the use of irrigation water and of wetlands for wildlife are major concerns of management.

3. Hastings-Massie association

Deep, very gently sloping and gently sloping, silty soils on loess uplands and deep, nearly level, silty soils that have a claypan subsoil in upland depressions

This association consists mainly of gently undulating and undulating uplands with many depressions and closed basins. Soils are mostly very gently sloping and gently sloping. Soils in the depressions and basins are nearly level.

This association makes up 24,100 acres or about 7 percent of the county. It is about 58 percent Hastings soils, 7 percent Massie soils, and 35 percent soils of minor extent (fig. 4).

Hastings soils are mostly on very gently sloping and gently sloping divides. Some of these soils are on gently sloping sides of drainageways. These soils are well drained and have a surface layer that is mainly grayish brown silt loam. In eroded areas, the surface layer is silty clay loam. The subsoil is grayish brown and light brownish gray silty clay loam. The underlying material is pale brown silt loam.

Massie soils are in the lowest, wettest part of very poorly drained depressions. These soils have a cover of partially decayed leaves and stems over a very dark gray and dark gray silty clay loam surface layer. The thin subsurface layer is light gray silt loam. The very thick subsoil is mainly dark gray and gray silty clay. The underlying material is grayish brown silty clay loam.

Of minor extent are the Crete, Butler, Fillmore, and Scott soils. Crete soils are very gently sloping. Butler soils are nearly level and have slightly concave slopes. Fillmore and Scott soils are in poorly drained and very poorly drained depressions, and in some areas form a ring around the Massie soils.

Farms in this association are diversified and are mainly the combination cash-grain and livestock type. They average about 320 acres. The undulating soils are used for irrigated crops, such as corn, and dryland crops, such as grain sorghum and wheat. Most irrigation is done by the center-pivot sprinkler system. Most areas of rangeland are small and are mainly on the Fillmore and Scott soils and the adjacent sloping soils. The larger areas of grassland are part of the National Wildlife Management Areas. These areas and the Massie soils are mainly used as habitat for wetland wildlife.

Water erosion is the main hazard in cultivated areas of Hastings and Crete soils. Fillmore, Scott, and Massie soils are ponded with water for long and very long periods from March to about August. In wet years, the Massie soils and some areas of Scott soils can be ponded with water throughout the year. Proper management is needed in wildlife areas.

Gravel or improved dirt roads are on most section lines except where they are intercepted by large basins. Paved highways cross most parts of this association. Grain, livestock, and other farm products are marketed mainly in the county and adjacent counties.

well drained soils on uplands

The association in this group makes up about 1 percent of the county. The soils are nearly level and very gently sloping. Nearly all of the acreage of this association is cultivated except for small areas of introduced or native grasses near farmsteads and on narrow areas between steep drainageways. Most of the acreage that is cultivated is in dryland crops. A small part is irrigated by the gravity system, but wells have

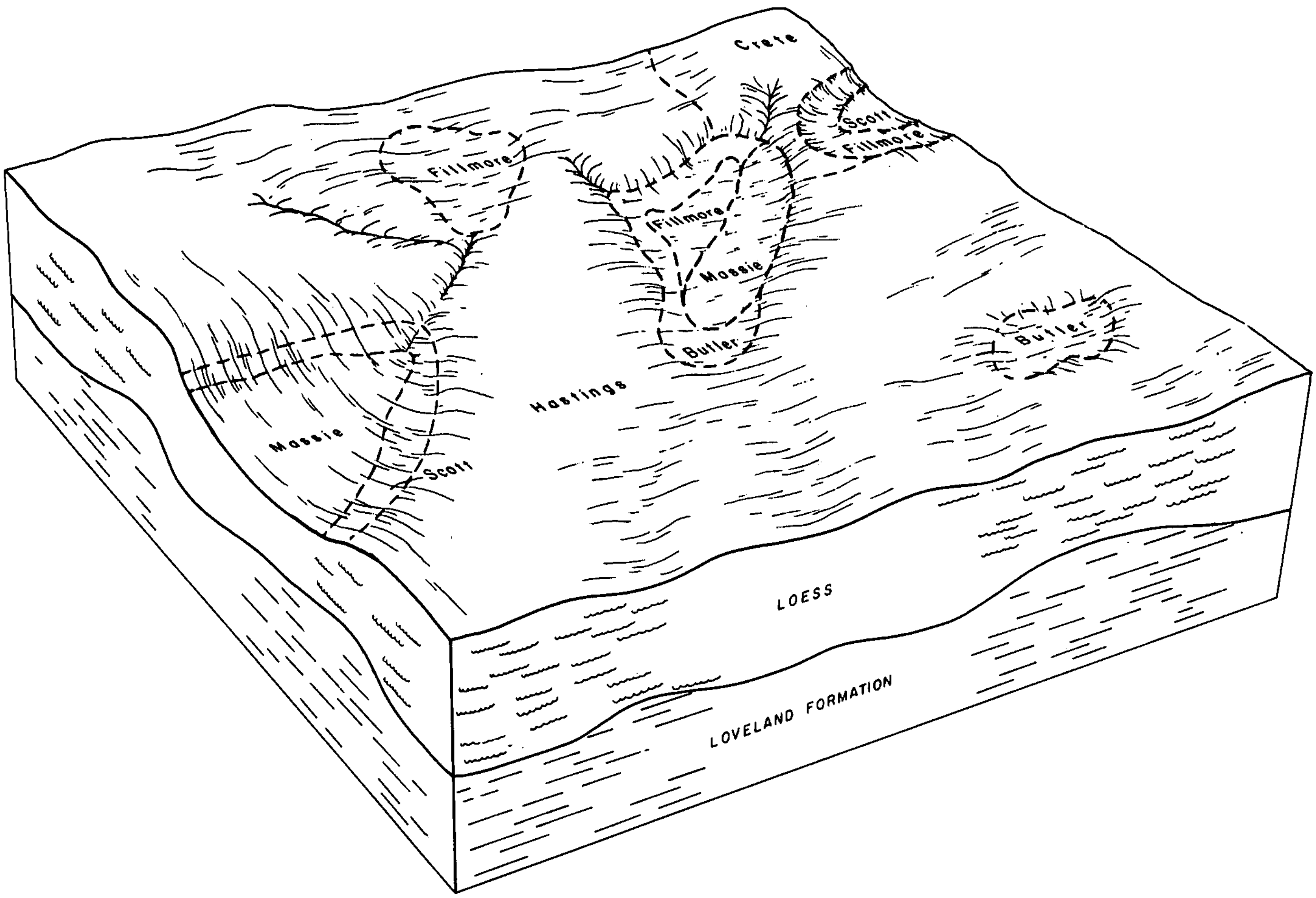

Figure 4.—Typical pattern of soils in the Hastings-Massie association showing the relationship of the soils to topography and parent materials.

poor yields. Soil blowing is the main hazard. Conserving moisture for plants is a major concern of management.

4. Hall-Hastings association

Deep, nearly level and very gently sloping, silty soils on loess uplands

This soil association consists of uplands and well defined drainageways. Soils are mostly nearly level, but some are very gently sloping. The soils on the sides of the drainageways are mainly gently sloping.

This association makes up 4,055 acres or about 1 percent of the county. It is about 80 percent Hall soils, 8 percent Hastings soils, and 12 percent soils of minor extent.

Hall soils are on the broad, nearly level uplands south of the Little Blue River in the southwestern part of the county. These soils are well drained and have a grayish brown and dark grayish brown silt loam surface layer. The subsoil is dark grayish brown, brown, and pale brown silty clay loam. The underlying material is very pale brown silt loam.

Hastings soils are mostly nearly level. Some of these soils are on the narrow, very gently sloping areas. The surface layer is dark grayish brown silt loam. The subsoil is dark grayish brown, brown, and pale brown silty clay loam. The underlying material is pale brown silt loam.

Of minor extent are the Uly, Holder, Fillmore, and Geary soils. Uly and Geary soils are on the moderately steep and steep sides of drainageways. Holder soils are on the gently sloping sides of drainageways. Fillmore soils are in depressions.

Farms in this association are mainly the combination cash-grain and livestock type. They average about 280 acres. Some livestock are fattened from grain grown locally. The soils are mainly used for dryland crops. Grain sorghum and wheat are the main crops. Irrigation is limited because of the absence of available ground water. Corn is the main irrigated crop.

Soil blowing is a hazard on the nearly level cultivated soils. Water erosion is the main hazard on the sloping cultivated soils. Maintenance of irrigation water is an important concern on irrigated land.

Gravel or improved dirt roads are on most section lines. No paved highways cross this association. Grain, livestock, and other farm products are marketed mainly in the county and in adjacent counties.

well drained and somewhat excessively drained soils on uplands

The three associations in this group make up about 13 percent of the county. The soils are very gently sloping to steep. Most of the acreage of these associations is cultivated except for the steep areas that are mostly in native or introduced grasses.

Some of the acreage is irrigated, mainly by the sprinkler system. Water erosion is the main hazard. Maintaining a high level of fertility for plants and planned grazing of rangeland are concerns of management.

5. Holder-Uly association

Deep, gently sloping to steep, silty soils on loess uplands

This soil association consists of the slopes adjacent to the upland drainageways and of slopes of upland breaks to stream terraces and bottom lands (fig. 5). The slopes are gently sloping to steep.

This association makes up 23,300 acres or about 6 percent of the county. It is about 45 percent Holder soils, 15 percent Uly soils, and 40 percent soils of minor extent.

Holder soils are on the gently sloping and strongly sloping sides of drainageways and upland breaks. They are well drained. Eroded areas of these soils have a brown silty clay loam surface layer. The subsoil is mainly brown and pale brown silty clay loam. The underlying

Figure 5.—Landscape of Holder-Uly association and Hord-Hobbs association. Sloping Holder soils in the foreground break to the nearly level Hord and Hobbs soils in the background.

material is very pale brown silt loam. Uneroded areas of these soils have a grayish brown silt loam surface layer.

Uly soils are on the moderately steep and steep sides of drainageways and upland breaks. These soils are somewhat excessively drained and have a grayish brown, silt loam surface layer. The subsoil is mainly brown and pale brown silt loam. The underlying material is very pale brown silt loam. Eroded areas of these soils have a brown silt loam surface layer.

Of minor extent are the Hastings, Hobbs, Hord, and Geary soils. Hastings soils are on nearly level and very gently sloping, narrow uplands and on gently sloping sides of drainageways. Geary soils are in lower positions on the gently sloping to steep sides of drainageways and on upland breaks. Hobbs soils are on bottom lands. Hord soils are on terraces or colluvial foot slopes.

Farms in this association are mainly the combination cash-grain and livestock type. They average about 200 acres. Grain sorghum, wheat, and alfalfa are the principal crops. Some of the strongly sloping soils and nearly all of the steep soils are used for range. Some livestock are fattened in feedlots or raised for breeding stock.

Water erosion is the main hazard on the sloping cultivated soils. Low fertility is a limitation on the eroded soils. The strongly sloping and steep soils are limitations for irrigation. Flooding is a hazard on the bottom lands. Proper management of rangeland is a concern.

Gravel or improved dirt roads are on most section lines. Paved highways cross parts of this association. Grain, livestock, and other farm products are marketed mainly in the county and in adjacent counties.

6. Hastings-Uly association

Deep, very gently sloping to steep, silty soils on loess uplands

This association consists of the sides of drainageways and upland breaks to stream terraces or bottom lands. The slopes are gently sloping to steep.

This association makes up 10,000 acres or 3 percent of the county. It is about 63 percent Hastings soils, 7 percent Uly soils, and 30 percent soils of minor extent.

Hastings soils are on the very gently sloping to strongly sloping sides of drainageways and are well drained. Eroded areas of these soils have a brown silty clay loam surface layer and a subsoil that is mainly brown and pale brown silty clay loam. The underlying material is very pale brown silt loam. Uneroded areas of these soils have a grayish brown silt loam surface layer.

Uly soils are on the moderately steep and steep sides of drainageways and upland breaks. They are somewhat excessively drained soils with a grayish brown silt loam surface layer. The subsoil is mainly brown and pale brown silt loam. The underlying material is very pale brown silt loam. Eroded areas of these soils have a brown silt loam surface layer.

Of minor extent are the Hobbs, Hord, and Geary soils. Hobbs soils are on the bottom lands. Hord soils are on low terraces or colluvial foot slopes adjacent to bottom lands. Geary soils are in lower positions on gently sloping to steep sides of drainageways.

Farms in this association are mainly the combination cash-grain and livestock type. They average about 200 acres. The soils are mainly used for dryland crops and range. Grain sorghum, wheat, and alfalfa are the principal crops. Some of the strongly sloping and nearly all of the steep soils are used for range. Some livestock are fattened in feedlots or raised for breeding stock.

Water erosion is the main hazard on the sloping cultivated soils. Low fertility is a limitation on the eroded soils. The strongly sloping and steep soils are limitations for irrigation. Flooding is a hazard on the bottom land soils. Proper management of rangeland is a concern.

Gravel or improved dirt roads are on most section lines. Paved highways cross most segments of this association. Grain, livestock, and other farm products are marketed mainly in the county and in adjacent counties.

7. Geary-Holder-Uly association

Deep, gently sloping to steep, silty soils on loess uplands

This association consists of alternating drainageways and narrow divides and upland breaks to stream terraces or bottom lands. The soils on the sides of drainageways and upland breaks are gently sloping to steep, and those on the narrow divides are gently sloping and strongly sloping.

This association makes up 15,650 acres or about 4 percent of the county. It is about 34 percent Geary soils, 34 percent Holder soils, 9 percent of Uly soils, and 23 percent soils of minor extent (fig. 6).

Geary soils are on the lower side slopes of drainageways and upland breaks to stream terraces. Some of these soils are on narrow, convex divides below the Holder soils and between steep drainageways. Slopes range from gently sloping to steep. The moderately steep and steep areas of these Geary soils are somewhat excessively drained and have a grayish brown silt loam surface layer except where eroded. The gently sloping and strongly sloping areas of these soils are well drained and have a dark grayish brown silt loam surface layer. The eroded areas of these soils have a brown silty clay loam surface layer. The subsoil is brown and light brown silty clay loam. The underlying material is light brown silty clay loam.

Holder soils are on the convex slopes above the Geary soils and between steep drainageways. Some areas of the Holder soils are on the upper side slopes of upland breaks to stream terraces or bottom lands. The gently sloping or strongly sloping Holder soils are well drained and have a grayish brown silt loam surface layer. Eroded areas of these soils have a brown silty clay loam surface layer. The subsoil is mainly brown and pale brown silty clay loam. The underlying material is very pale brown silt loam.

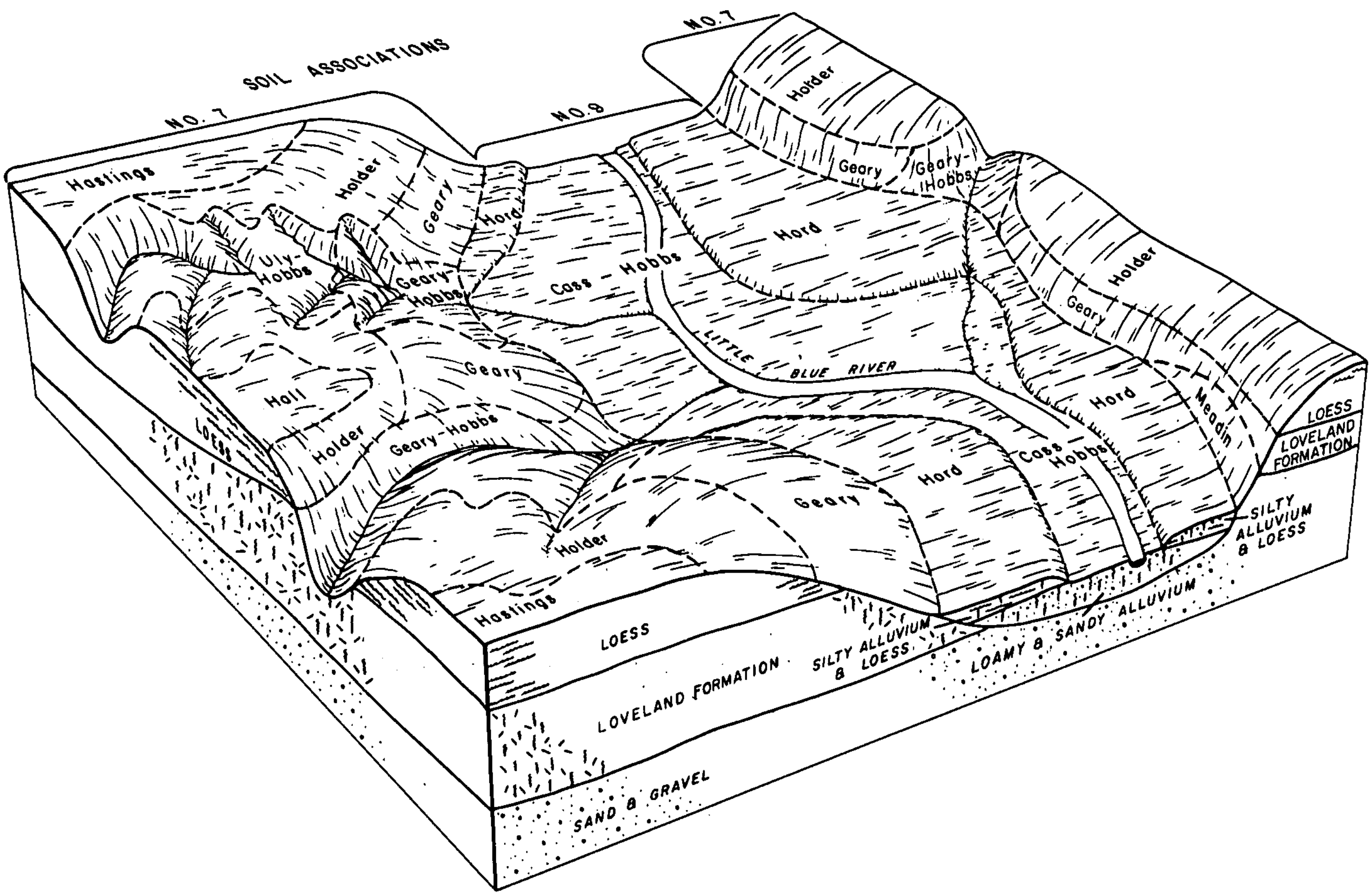

Figure 6.—Typical pattern of soils in the Geary-Holder-Uly and the Hord-Cass-Hobbs associations showing the relationship of the soils to topography and parent materials.

Uly soils are mainly on the upper side slopes of drainageways and upland breaks to stream terraces or bottom lands. Slopes are moderately steep and steep. These soils are somewhat excessively drained and have a grayish brown silt loam surface layer. Eroded areas of these soils have a brown silt loam surface layer. The subsoil is brown, pale brown, and very pale brown silt loam.

Of minor extent are the Hobbs, Hastings, Meadin, Hord, and Hall soils. Hobbs soils are on bottom lands. Hastings soils are on the nearly level to very gently sloping, narrow, intervening divides and some gently sloping sides of drainageways, generally above the Holder soils. Those Hastings soils in the drainageways are adjacent to the nearly level Crete soils on uplands. Meadin soils are on the sides of drainageways and low ridges of gravelly uplands. These soils are also on the lower side slopes of upland breaks to stream terraces or bottom lands. Meadin soils are below the Geary soils and are mostly along the Little Blue River. Hord soils are only on stream terraces and colluvial foot slopes. The nearly level Hall soils are on uplands.

Farms in this association are diversified and are mainly the combination cash-grain and livestock type. They average about 220 acres. The soils are mainly used for dryfarmed crops and range. Grain sorghum, wheat, and alfalfa are the principal crops. Most of the narrow, convex divides between steep drainageways and nearly all of the steep soils are in range. Most of the Meadin soils are in range. Some livestock are fattened and some raised for breeding stock.

Water erosion is the main hazard on the cultivated soils. Flooding is a hazard, and meandering channels are limitations on the less extensive Hobbs soils. Low fertility is a limitation on the eroded soils. The shallow root zone of the less extensive Meadin soils limits the available water capacity. Irrigation is limited to the gentler slopes. Proper management of rangeland is a concern.

Gravel or improved dirt roads are on most section lines and are interrupted at intervals by the absence of bridges across the Little Blue River or by the steep slopes along the river. Paved highways cross parts of this association.

Sources of gravel and sand can be located in the Meadin soils. Large gravel and sand pits are located near the mouth of Pawnee Creek and by Deweese. Grain, livestock, and other farm products are marketed mainly within the county and in adjacent counties.

well drained soils on stream terraces and bottom lands

The two associations in this group make up about 3 percent of the county. The soils are nearly level and very gently sloping. Most of the acreage of these associations is cultivated, and the rest is in native or introduced grasses and trees. Some of the acreage is irrigated, mainly by the gravity system. Flooding is the main hazard. Maintaining soil fertility and conserving soil moisture for plants are the main concerns of management.

8. Hord-Hobbs association

Deep, nearly level and very gently sloping, silty soils on stream terraces and bottom lands

This association consists of terraces and bottom lands along perennial and intermittent streams (fig. 5). The soils on the terraces are mostly nearly level, but some are very gently sloping. The soils on the bottom lands are nearly level and very gently sloping except on steep sides of meandering stream channels.

This association makes up 4,950 acres or about 1 percent of the county. It is about 61 percent Hord soils, 37 percent Hobbs soils, and 2 percent soils of minor extent.

Hord soils are on nearly level, low stream terraces; on very gently sloping, colluvial foot slopes between the uplands and terraces; and on sides of a few very gently sloping drainageways that cross the terraces. These soils are well drained and have a thick, gray and dark gray silt loam surface layer. The subsoil is dark grayish brown and grayish brown silt loam. The underlying material is brown silt loam.

Hobbs soils are on the nearly level bottom lands. These soils are well drained and have a stratified, grayish brown and pale brown silt loam surface layer. The underlying material is mainly silt loam. It is stratified, grayish brown, dark gray, and pale brown.

Of minor extent are the Holder and Uly soils. These soils are on the sides of drainageways that cross the terraces.

Farms in this association are mainly the combination cash-grain and livestock type. They average about 160 acres. Soils on the terraces are mainly used for dryland and irrigated crops. Corn is the major irrigated crop. Grain sorghum, alfalfa, and wheat are the main dryland crops. Most of the soils on the bottom lands are in range. Some areas of soils on the bottom lands are planted to trees and provide habitat for wildlife. Some livestock are fattened and some raised for breeding stock.

Soil blowing is a slight hazard on the nearly level Hord soils. Water erosion is the main hazard on the very gently sloping cultivated soils. Frequent flooding is the main hazard on the bottom lands. Management of irrigation water is important on irrigated land.

Gravel or improved dirt roads are on most section lines. Grain, livestock, and other farm products are marketed mainly in the county and in adjacent counties.

9. Hord-Cass-Hobbs association

Deep, nearly level and very gently sloping, silty and loamy soils on stream terraces and bottom lands

This association consists of terraces and bottom lands. The soils on the terraces and bottom lands are mostly nearly level, but some are very gently sloping.

This association makes up 6,200 acres or about 2 percent of the county. It is about 40 percent Hord soils, 30 percent Cass soils, 25 percent Hobbs soils, and 5 percent soils of minor extent (fig. 6).

Hord soils are on the nearly level, mostly high and some low stream terraces; on very gently sloping, colluvial foot slopes between the uplands and terraces; and on sides of a few very gently sloping drainageways that cross the terraces. These soils are well drained and have a thick, gray and dark gray silt loam surface layer. The subsoil is dark grayish brown and grayish brown silt loam. The underlying material is brown silt loam.

Cass soils are only on the bottom lands of the Little Blue River and its tributaries. These soils are nearly level and well drained and have a grayish brown and dark grayish brown silt loam surface layer. The transitional layer is grayish brown loam. The underlying material is stratified, brown to very pale brown, very fine sandy loam to coarse sand.

Hobbs soils are on the nearly level bottom lands. These soils are well drained and have a grayish brown silt loam surface layer. The underlying material is stratified, grayish brown to pale brown silt loam and loam.

Of minor extent are the Holder, Uly, and Meadin soils. The Holder and Uly soils are on sloping terrace edges and on sides of drainageways crossing the terraces. The Meadin soils are on colluvial foot slopes.

Farms in this association are mainly the combination cash-grain and livestock type. They average about 240 acres. The soils on the terraces are mainly used for dryland and irrigated crops. About half of the acreage of soils on the bottom lands are used for crops. Mostly dryland crops are grown. The other half is in native grass and trees, which are used for grazing or for providing wildlife habitat. Corn is the major irrigated crop. Grain sorghum, alfalfa, and wheat are the main dryland crops. Some livestock are fattened and some raised for breeding stock.

Soil blowing is a slight hazard on the nearly level terrace soils. Water erosion is the main hazard on the very gently sloping cultivated soils. Occasional flooding is the main hazard on the bottom land soils. Low moisture supply can be a limitation on the Cass soils. Management of irrigation water is important on irrigated land.

Gravel or improved dirt roads are on most section lines and are interrupted at intervals by the absence of bridges across the Little Blue River. Only one paved highway crosses this association, but others are nearby. Sources of sand and some gravel can be located in the Cass soils. Grain, livestock, and other farm products are marketed mainly within the county and in adjacent counties.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Hastings silt loam, 0 to 1 percent slopes, is one of several phases in the Hastings series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Uly-Hobbs silt loams, 0 to 30 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, Gravel, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

Bu—Butler silt loam, 0 to 1 percent slopes. This deep, nearly level, somewhat poorly drained, claypan soil is mostly on flat or slightly concave areas of uplands. Some areas are in broad basins of uplands. A few areas are in slightly concave positions on stream terraces. Most individual areas are teardrop shaped with the point near the heads of drainageways. Other areas are irregular or somewhat oblong in shape. Individual areas mainly range from 5 to 160 acres, but the areas in the broad basins range from 640 to 2,500 acres.

Typically, the surface layer is grayish brown, very friable silt loam about 10 inches thick. The subsurface layer is gray, very friable silt loam about 1 inch thick. The subsoil is about 27 inches thick. It is very dark gray, very firm silty clay in the upper part; dark grayish brown, very firm silty clay in the middle part; and grayish brown, firm, calcareous silty clay loam in the lower part. The underlying material is grayish brown and light brownish gray, calcareous silt loam to a depth of 60 inches. In some areas the surface layer is neutral in reaction and less than 8 inches or more than 14 inches thick as a result of fills made during land leveling. Most broad basin areas have a surface layer that is 5 to 8 inches thick. In some cultivated areas, material from the leached subsurface layer has been mixed with the original surface layer. The result is a surface layer that has a faint gray cast when dry. Also, in some areas the lime is at depths of 20 to 25 inches.

Included with this soil in mapping, and making up 15 percent or less of the map unit, are small areas of Crete and Fillmore soils and deep cuts where the clayey subsoil is exposed at the surface as a result of land leveling. Crete soils are in slightly higher positions on the landscape and are better drained. Fillmore soils are in depressions and are more poorly drained than this Butler soil, unless drainage has been altered by land leveling.

Permeability is slow and the water intake rate is low in the claypan subsoil of this Butler soil. The available water capacity is high, but moisture is released slowly to plants. Runoff is slow. Water is ponded for brief periods following heavy rain. A perched seasonal high water table is at a depth of 1/2 foot to 3 feet. Tilth is good. The organic matter content is moderate, and natural fertility is medium. In areas where the subsoil is exposed by land leveling, however, organic matter content is low, tilth is poor, and available zinc is deficient. The shrink-swell potential is moderate in the surface and subsurface layers and high in the subsoil.

Most areas of this soil are farmed. Most areas are irrigated, but some are dryfarmed. The rest is in native grass and is generally adjacent to wetlands.

If used for dryland farming, this soil is suited to corn, grain sorghum, small grain, and grasses and legumes for hay and pasture. Grain sorghum and small grain are better able to tolerate the slow release of moisture from the claypan subsoil. Also, small grain, such as wheat, matures before the weather becomes hot and dry.

Conservation tillage practices that leave crop residue on the soil help to conserve soil moisture and prevent soil blowing. Runoff from adjacent areas often ponds on this soil for a few hours or days, especially during spring. The excess water delays tillage and can retard crop growth, but crop failures are infrequent. Field terraces on the higher, adjacent areas reduce runoff. Puddling and compaction occur if this soil is tilled when wet. When dry, the soil is hard and difficult to work.

The return of crop residue, green manure crops, and barnyard manure to this soil increases fertility and reduces crusting and compacting. Tilth and the water intake rate are also improved. The inclusion of a deep rooted legume, such as alfalfa, in the cropping sequence opens compacted layers and the claypan subsoil, thereby improving water movement as well as fertility and tilth. Crop rotation interrupts weed, insect, and disease cycles. Crop stubble left standing on the surface throughout winter reduces snow and soil blowing in the cultivated areas.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture. Land leveling improves surface drainage and uniform distribution of water in a gravity irrigation system. Cutting into the clayey subsoil should be avoided as much as possible because tillage and seedling establishment are difficult on these sites. Sprinkler irrigation can help seedlings penetrate a crusted surface layer. Adding zinc and organic matter helps to improve fertility and tilth in these areas. Applying water at a rate suited to the low water intake rate of this soil reduces runoff of irrigation water. If the gravity irrigation system is used, water should be applied more often to this soil than for soils that have moderately low or moderate intake rates. The length of the run should be longer than for soils that have a higher intake rate. Runoff of irrigation water should be conserved by tailwater recovery systems.

This soil is suited to use as rangeland. The grasses are effective in controlling soil blowing. Overgrazing reduces the protective vegetation, and grazing when the soil is too wet compacts the surface layer, slows the water intake rate, and damages the crowns of the plants. Proper grazing, a planned grazing system of use and rest, and restricted use during wet periods help to keep the grasses and the soil in good condition.

This soil is suited to growing trees in windbreaks. The selected trees should be able to tolerate occasional wetness. Establishment of seedlings can be difficult in wet years because of ponding of excess water. The soil should be tilled and seedlings planted when the soil is moist but not wet. This soil has high shrink-swell potential and cracks in dry seasons, allowing air to dry out the roots of shallow rooted plants. Light cultivation after heavy rains can help to prevent cracks at the surface, but supplemental water is needed to keep the subsoil from cracking or to close existing cracks.

Slow permeability and wetness are limitations for septic tank absorption fields. Alternate sites should be selected on adjacent more permeable soils if available. Sewage lagoons require compacted embankments for protection from ponded water. The brief ponding of water and high shrink-swell potential of the subsoil are limitations for dwelling and building sites. Wetness, low strength, and potential frost action are limitations for roads and streets. Providing good drainage and strengthening or replacing the base material helps overcome these limitations.

This soil is in capability units IIw-2, dryland, and IIw-2, irrigated; the Clayey range site; and windbreak suitability group 2w.

Ca—Cass fine sandy loam, overwash, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on occasionally flooded bottom lands along perennial streams. Individual areas are long and narrow or somewhat oblong and range from 5 to 30 acres.

Typically, the surface layer is stratified, grayish brown and brown, very friable fine sandy loam about 10 inches thick. The transitional layer, about 4 inches thick, is brown, very friable loam. The underlying material to a depth of about 60 inches is pale brown loamy sand in the upper part; stratified, brown and very pale brown fine sandy loam in the middle part; and very pale brown coarse sand in the lower part. In some areas the surface layer is less than 10 inches thick and sandier or loamier than typical because of recent stream deposition. Some areas have dark loamy layers in the lower part of the profile. Gravelly sand is above a depth of 40 inches in some areas.

Included with this soil in mapping, and making up 10 percent or less of the map unit, are small areas of Hobbs soils and soils in slightly lower areas of old meandering stream channels. The Hobbs soils are in the same position on the landscape as this Cass soil but are mostly silt loam. The soils in the lower positions have more clay in the surface layer.

Permeability is moderately rapid in the upper part of this Cass soil and rapid in the lower part. The available water capacity is moderate, moisture is released readily to plants, and the water intake rate is moderately high. Runoff is slow. This very friable soil is easily tilled. The shrink-swell potential is low. The organic matter content is moderately low, and natural fertility is medium.

About half of the acreage of this soil is farmed. The other half is in native grasses and trees and is used for grazing and as habitat for wildlife. Some of the farmed areas are irrigated, but most are not.

If used for dryland farming, this soil is suited to corn, grain sorghum, small grain, and legumes and grasses for hay and pasture. Occasional flooding, although brief in duration, can delay planting and tillage or damage crops by scouring and sedimentation. If flooding occurs in spring, crops that have a shorter growing season can be replanted later in the growing season. Areas of this soil that are adjacent to streams should be left in grass and trees to prevent streambank erosion. Soil blowing can be a hazard on unprotected cultivated areas. Leaving crop residue on the soil and leaving crop stubble standing throughout winter help to reduce soil blowing and drifting snow. Low moisture supply can be a limitation during periods of drought. Crop residue, green manure crops, and barnyard manure need to be returned to this soil to increase the moderately low organic matter content.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture. Irrigation by center-pivot sprinklers is generally limited because of the size and shape of the areas. This soil has a good intake rate if gravity irrigation is used. Because of the moderate available water capacity, the water may need to be applied more often. The length of the run should be shorter than for soils that have a lower intake rate. Furrows are washed out occasionally by flooding. Using levees and diversions can lessen this occurrence.

This soil is suited to use as rangeland. Grasses effectively control soil blowing. Occasional flooding causes sedimentation and introduces weeds that can deteriorate the native plant community. Weeds and grazing need to be controlled so that desirable grasses can be reestablished. Native grasses that are tolerant of slightly sandy soils should be used.

This soil is suited to growing trees in windbreaks. The trees should be able to tolerate the slightly sandy, somewhat droughty conditions. Soil blowing can be prevented by maintaining strips of sod or a cover crop between the rows of trees. Seedlings may need supplemental water during dry seasons. Occasional flooding can delay the establishment of seedlings; however, the additional moisture is beneficial once seedlings are established. The water table is at a depth of 6 to 10 feet and is very beneficial for older trees. Younger trees must be protected from livestock grazing.

This soil is not suited to use as building sites or septic tank absorption fields because of the hazard of occasional flooding. Suitable sites can generally be located on adjacent soils in higher positions that are not subject to flooding. Sewage lagoons need to be diked as protection from flooding and need sealing to prevent seepage into ground water. Roads may be damaged and closed during floods and may need rebuilding. They need to be constructed on raised, well compacted fill material with adequate culverts and bridges.

This soil is in capability units IIs-6, dryland, and IIs-8, irrigated; the Sandy Lowland range site; and windbreak suitability group 1.

Cd—Cass silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on occasionally flooded bottom lands along perennial and intermittent streams. It formed in mixed, sandy and loamy alluvium. Individual areas are long and narrow and range from 5 to about 280 acres.

Typically, the surface layer is grayish brown and dark grayish brown, very friable silt loam 12 inches thick. The transitional layer, about 5 inches thick, is grayish brown, very friable loam. The stratified underlying material to a depth of about 60 inches is brown very fine sandy loam in the upper part, pale brown and very pale brown fine sand and loamy fine sand in the middle part, and very pale brown coarse sand in the lower part. In some areas, the surface layer is less than 10 inches thick and is sandier and loamier. It is dark to a depth of more than 20 inches in a few areas. Dark loamy layers are in the lower part of the profile in some areas. Some areas have gravelly sand above a depth of 40 inches.

Included with this soil in mapping, and making up 15 percent or less of this map unit, are small areas of Hobbs soils and small areas that are frequently flooded. Also included are small wet areas in which the surface layer is silty clay loam, carbonates are present above a depth of 25 inches, and the seasonal high water table is at a depth of 2 feet or less. The Hobbs soils are in the same position on the landscape as this Cass soil, but the surface layer and underlying material are silt loam. Included are frequently flooded, channeled areas on slightly lower bottom lands. The wet areas are mostly in old river channels and oxbows.

Permeability is moderately rapid in the upper part and rapid in the lower part of this Cass soil. The available water capacity is moderate, moisture is readily released to plants, and the water intake rate is moderately high. Runoff is slow. This friable soil is easily tilled. The shrink-swell potential is low. The organic matter content is moderately low, and natural fertility is high. The seasonal high water table is at a depth of 6 to 10 feet and is highest from March through June.

About two-thirds of the acreage of this soil is in native grass and trees. This area is mainly used for grazing; a few areas are used as wildlife habitat. The rest is farmed and irrigated in places.

If used for dryland farming, this soil is suited to corn, grain sorghum, small grain, and legumes and grasses for hay and pasture. Occasional flooding, although brief in duration, can delay planting and tillage or damage crops through scouring and sedimentation. Alfalfa and small grain can be easily damaged by flooding. In dry years, however, some areas in row crops benefit from the extra moisture. If flooding occurs in spring, crops that have a shorter growing season can be replanted later in the growing season. Floodwater can be retained by levees, intercepted by diversions, or drained by ditches in most areas of this soil. Areas adjacent to streams should be left in grasses and trees to prevent streambank erosion.

Low moisture supply may be a limitation during periods of drought. Crop residue, green manure crops, and barnyard manure need to be returned to the soil to improve the moderately low organic matter content, fertility, and moderate available water capacity. Immediate incorporation of the barnyard manure or fertilizer is necessary so that floodwater does not carry it downstream, thereby possibly creating a health hazard.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture. The shape and size of areas of this soil, as influenced by perennial streams and steep upland soils, are limitations for irrigating with center-pivot sprinklers. If the gravity irrigation system is used, this soil has a good water intake rate. The water may need to be applied more often, however, because of the moderate available water capacity. The length of the run should be shorter than for soils with a lower intake rate. Furrows can be washed out occasionally by floodwater. Using levees and diversions can lessen this occurrence.

This soil is suited to rangeland. Occasional flooding causes sedimentation and introduces weeds which can deteriorate the native plant community. Weeds and grazing need to be controlled so that desirable grasses are allowed to reestablish.

This soil is suited to growing trees in windbreaks. Occasional flooding can delay or limit the establishment of seedlings. Once seedlings are established, however, the additional moisture is beneficial. The water table is at a depth of 6 to 10 feet and is very beneficial for older trees. Competitive grasses, weeds, and shrubs need to be controlled until trees are established. Young trees must be protected from livestock grazing.

This soil is not suited to use as building sites or septic tank absorption fields because of the hazard of occasional flooding. Suitable sites can generally be located on adjacent soils in higher positions that are not subject to flooding. Sewage lagoons need to be diked as protection from flooding, and they need to be sealed to prevent seepage into ground water. Roads may be damaged and closed during floods and may need rebuilding. They need to be constructed on raised, well compacted fill material with adequate culverts and bridges.

This soil is in capability units IIw-3, dryland, and IIw-8, irrigated; the Sandy Lowland range site; and windbreak suitability group 1.

Ce—Crete silt loam, 0 to 1 percent slopes. This deep, nearly level, moderately well drained, claypan soil is on slightly convex, flat, and slightly concave divides of the uplands. The slightly concave areas are mostly near the heads of drainageways. Individual areas are mostly large and irregular in shape and range from 5 to 3,000 acres.

Typically, the surface layer is gray and dark gray, very friable silt loam about 10 inches thick. The subsoil is about 22 inches thick. The upper part is dark grayish brown, firm silty clay loam; the middle part is brown, very firm silty clay; and the lower part is brown, firm, calcareous silty clay loam. The underlying material is pale brown, calcareous silt loam to a depth of about 60 inches. In some areas, the surface layer is less than 5 inches thick as a result of cuts made during land leveling.

Included with this soil in mapping, and making up 15 percent or less of this map unit, are small areas of Hastings, Butler, and Fillmore soils and deep cuts in which the lighter colored subsoil or underlying material is exposed at the surface as a result of land leveling. Hastings soils are in the same or higher positions on the landscape but are better drained than this Crete soil. Butler and Fillmore soils are in lower positions on the landscape and are more poorly drained than the Crete soil. Some of the low lying Fillmore soils have been raised with fill material, and the surface drainage has been improved.

Permeability is slow and the water intake rate is low in the claypan subsoil of this Crete soil. The available water capacity is high, but moisture is released slowly to plants. Runoff is slow. In the very friable surface layer, tilth is good, organic matter content is moderate, and natural fertility is medium. In areas that have been leveled and have the subsoil at the surface, organic matter content is low, tilth is poor, and available zinc is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Most areas of this soil are farmed. The rest is in native grass. Most farmed areas are irrigated, but some are not. The areas of native grass are generally adjacent to or between steep drainageways.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay. The soil is moderately well suited to corn. Grain sorghum and small grain can tolerate the slow release of moisture from the claypan subsoil. Also, small grain, such as wheat, matures before the weather becomes hot and dry.

Conservation tillage practices that leave crop residue on the surface conserve soil moisture and prevent soil blowing. The surface layer of this soil is often saturated with water in spring, which can delay tillage. Puddling and compaction occur if the soil is tilled when it is too wet. After drying, the soil becomes hard and difficult to work. Returning crop residue and green manure crops to the soil and applying barnyard manure increase the organic matter content and fertility and reduce crusting and compacting. Tilth and the water intake rate are improved. Including a deep rooted legume, such as alfalfa, in the cropping sequence opens compacted layers and the claypan subsoil for improved water movement as well as for improved fertility and tilth. Rotating crops interrupts weed, insect, and disease cycles. Leaving crop stubble standing throughout winter prevents soil blowing and catches drifting snow for additional soil moisture.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture (fig. 7). Land leveling improves surface gradient and improves uniform distribution of water in the gravity irrigation system. Cutting into the claypan subsoil should be avoided as much as possible when leveling the land because tillage and seedling establishment are difficult on the exposed clayey material. Sprinkler irrigation can help soften a crusted soil. Adding zinc and organic matter can improve the fertility and tilth of these leveled areas. Applying water at a rate suited to the low water intake rate of this soil helps to conserve irrigation water. Using the gravity irrigation system, water should be applied more often to this soil than for soils that have moderately low or moderate intake rates. The length of the run should be longer than for soils that have higher intake rates. Runoff of irrigation water needs to be conserved by tailwater recovery systems (fig. 8).

This soil is suited to rangeland, which is effective in controlling soil blowing. Overgrazing reduces the protective vegetation and lowers the quantity and quality of the native plant community. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and keep the soil in good condition.

This soil is suited to growing moderately drought resistant trees in windbreaks. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Because of its high shrink-swell potential, this soil cracks in dry seasons, thereby allowing air to dry out roots.

Figure 7.—Irrigation by center-pivot sprinklers is used for corn on Crete silt loam, 0 to 1 percent slopes.

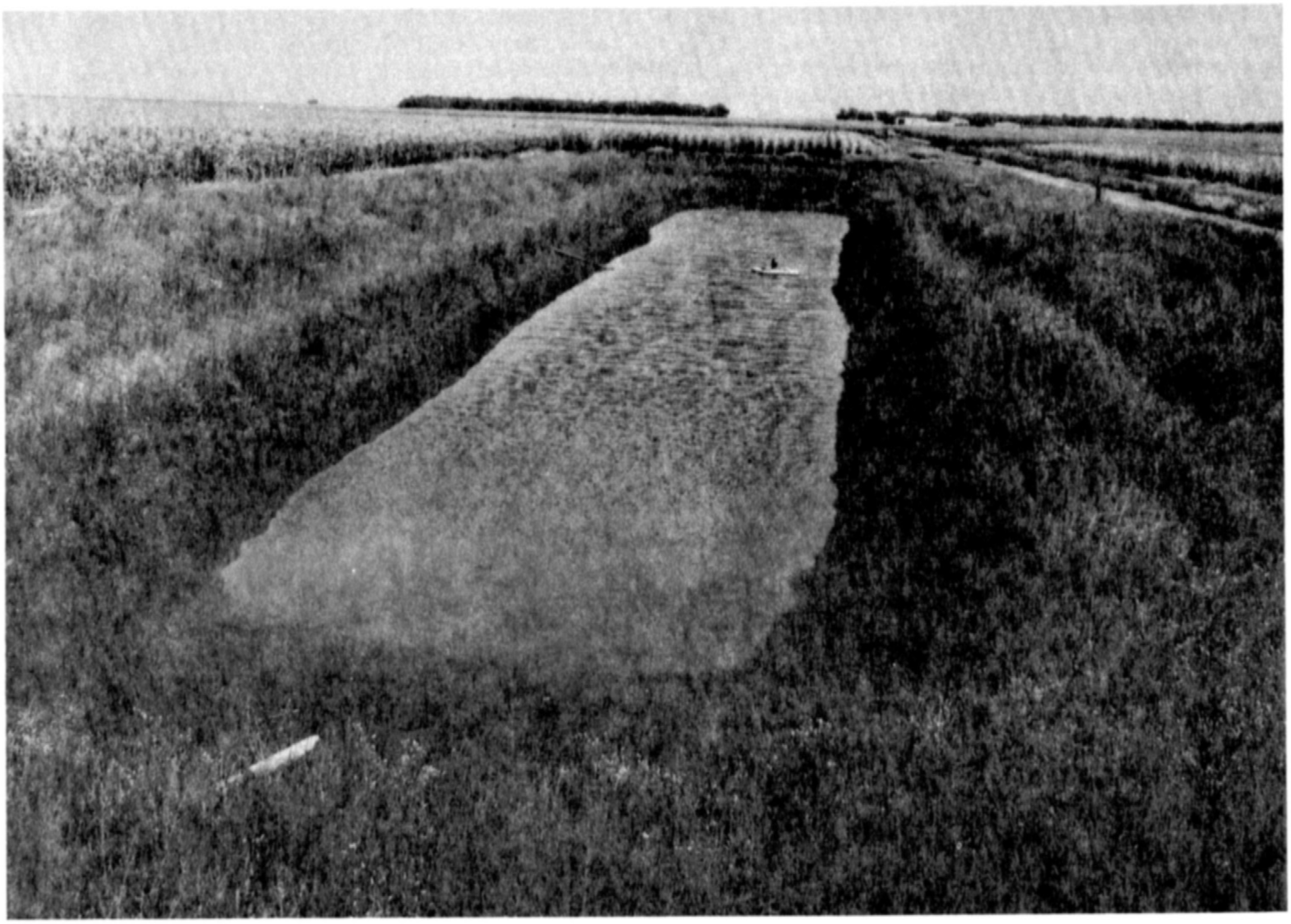

Figure 8.—Irrigation tailwater recovery pit with a self-priming pump on Crete silt loam, 0 to 1 percent slopes.

Light cultivation after heavy rains can reduce surface cracks, but supplemental water is needed to keep the subsoil from cracking or to close existing cracks.

Septic tank absorption fields are not suited to this soil because of the slow permeability. Alternate sites can be selected on adjacent, more permeable soils if they are available. Sewage lagoons need to be lined or sealed to prevent seepage. The high shrink-swell potential of the subsoil is a limitation for dwelling and building sites. Foundations and footings should be designed to prevent structural damage caused by the shrinking and swelling of this soil. Low strength, the high shrink-swell potential, and moderate frost action potential are limitations for roads and streets. Strengthening or replacing the base material helps to overcome these limitations.

This soil is in capability units IIs-2, dryland, and IIs-2, irrigated; the Clayey range site; and windbreak suitability group 4L.

CeB—Crete silt loam, 1 to 3 percent slopes. This deep, very gently sloping, moderately well drained, upland soil is on convex slopes of divides and sides of drainageways. Individual areas are irregular in shape and range from 5 to 200 acres.

Typically, the surface layer is grayish brown, very friable silt loam about 5 inches thick. The subsoil is about 25 inches thick. The upper part is dark grayish brown, friable silty clay loam; the middle part is dark grayish brown and grayish brown, very firm silty clay; and the lower part is light brownish gray, firm silty clay loam. The underlying material is light gray, calcareous silt loam to a depth of about 60 inches. In some cultivated areas, the surface layer is less than 5 inches thick and is mixed with material from the subsoil by plowing. Some areas have lime at a depth of less than 25 inches.

Included with the soil in mapping, and making up 20 percent or less of this map unit, are small areas of

Hastings soils and small severely eroded areas. Hastings soils are in the same or higher positions on the landscape and are better drained than the Crete soil. The severely eroded areas are lighter in color because the subsoil or underlying material is exposed at the surface.

Permeability is slow and the water intake rate is low in this Crete soil. The available water capacity is high, but moisture is released slowly to plants. Runoff is medium. In the very friable surface layer, organic matter content is moderate, natural fertility is medium, and tilth is good. In severely eroded areas, however, organic matter content is low, tilth is poor, and available phosphorus is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Most areas of this soil are farmed. The rest is in native grass. The cultivated areas are mostly used for dryland farming because many areas do not have available ground water for irrigation. The native grass areas are either adjacent to or between steep drainageways.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay and pasture. It is only moderately well suited to corn. Grain sorghum and small grain can tolerate the slow release of moisture from the claypan subsoil. Also, small grain, such as wheat, matures before the weather becomes hot and dry.

Water erosion can be controlled by using terraces, contour farming, and grassed waterways. Conservation tillage practices that leave crop residue on the soil also control water erosion and soil blowing and conserve soil moisture. Summer fallowing can be used to conserve moisture. Puddling and compaction occur if this soil is tilled when it is too wet. After drying, the soil is hard and is difficult to work, especially where the surface is eroded. Tillage should be delayed until the soil moisture content is low enough that puddling and compaction do not occur.

Returning crop residue and green manure crops to the soil and applying barnyard manure increase the organic matter content and fertility and reduce crusting and compacting. Tilth and the water intake rate are improved. Including a deep rooted legume, such as alfalfa, in the cropping sequence opens compacted layers and the claypan subsoil for improved water movement as well as improved fertility and tilth. Rotating crops interrupts weed, insect, and disease cycles. Leaving crop stubble standing throughout winter prevents soil blowing and catches drifting snow for additional soil moisture.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture. Additions of organic matter to eroded areas can improve tilth. Crops grown in these areas benefit from phosphate fertilizers. Applying water at a rate suited to this soil aids in reducing runoff of irrigation water. If the gravity irrigation system is used, contour bench leveling can be used to control water erosion. The tailwater recovery system is needed to conserve irrigation water.

This soil is suited to rangeland. Grasses are effective in controlling water erosion and soil blowing. Overgrazing reduces the protective vegetative cover, deteriorates the native plant community, and increases runoff and water erosion. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and to minimize erosion.

This soil is suited to growing moderately drought resistant trees in windbreaks. Where feasible, trees can be planted on the contour to reduce water erosion. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Because of its high shrink-swell potential, this soil cracks in dry seasons, thereby allowing air to dry out roots. Light cultivation after heavy rains can reduce surface cracking, but supplemental water is needed to reduce cracking of the subsoil or to close existing cracks.

Septic tank absorption fields are not suited to this soil because of the slow permeability. Alternate sites can be selected on adjacent, more permeable soils if they are available. Sewage lagoons need to be lined or sealed to prevent seepage. Where slope is 2 to 3 percent, grading is necessary to modify the slope and to shape the lagoon. The high shrink-swell potential of the subsoil is a limitation for dwelling and building sites. Foundations and footings should be designed to prevent structural damage caused by the shrinking and swelling of this soil. Low strength, the high shrink-swell potential, and moderate frost action potential are limitations for roads and streets. Strengthening or replacing the base material helps to overcome these limitations.

This soil is in capability units IIe-2, dryland, and IIe-2, irrigated; the Clayey range site; and windbreak suitability group 4L.

Cg—Crete silt loam, thick solum, 0 to 1 percent slopes. This deep, nearly level, moderately well drained soil is on slightly convex uplands. Individual areas of this unit are mostly broad and irregular in shape and range from 5 to 1,000 acres.

Typically, the surface layer is grayish brown and dark grayish brown, very friable silt loam about 12 inches thick. The subsoil is about 30 inches thick. The upper part is grayish brown, friable silty clay loam; the middle part is brown and pale brown, firm silty clay; the lower part is light yellowish brown, firm, silty clay loam. The underlying material is silt loam to a depth of about 60 inches. The noncalcareous material is light yellowish brown, and the calcareous material is pale yellow. In some areas the surface layer is less than 5 inches thick as a result of cuts and fills made during land leveling.

Included with this soil in mapping are small areas of Hastings, Butler, and Fillmore soils and deep cuts in which the lighter colored subsoil or underlying material is exposed at the surface as a result of land leveling.

Hastings soils are in the same or higher positions on the landscape but are better drained than this Crete soil. Butler and Fillmore soils are in lower positions on the landscape and are more poorly drained than the Crete soil. Some areas of the Fillmore soils have been buried under fill material and are moderately well drained.

Permeability is slow and the water intake rate is low in the subsoil of this Crete soil. The available water capacity is high, but moisture is released slowly to plants. Runoff is slow. In the very friable surface layer, tilth is good, organic matter content is moderate, and natural fertility is high. In areas where deep cuts were made during land leveling, however, organic matter content is low, tilth is poor, and available zinc is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Most areas of this soil are farmed. The rest is in native grass. Most farmed areas are irrigated, but some are not. The areas of native grass are either adjacent to or between steep drainageways.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay. Grain sorghum and small grain can tolerate the slow release of moisture from the subsoil best. Also, small grain, such as wheat, matures before the weather becomes hot and dry.

Conservation tillage practices that leave crop residue on the surface help to conserve soil moisture and to prevent soil blowing. Returning crop residue and green manure crops to the soil and applying barnyard manure increase the organic matter content and fertility and reduce crusting and compacting. Tilth and water intake rate are improved. Including a deep rooted legume, such as alfalfa, in the cropping sequence opens compacted layers and the subsoil for improved water movement as well as improved fertility and tilth. Rotating crops interrupts weed, insect, and disease cycles. Leaving crop stubble standing throughout winter prevents soil blowing and catches drifting snow for additional soil moisture.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture. Land leveling improves surface drainage and uniform distribution of water for the gravity irrigation system. Cutting into the subsoil should be avoided because tillage and seedling establishment are difficult on clayey sites. Adding zinc and organic matter can improve the fertility and tilth of these areas. Applying water at a rate suited to the low water intake rate of this soil aids in reducing runoff of irrigation water. If the gravity irrigation system is used, the water should be applied more often than for soils with moderately low or moderate intake rates. The length of the run is longer than for soils with higher intake rates. Runoff of irrigation water needs to be conserved by tailwater recovery systems.

This soil is suited to rangeland. Grasses are effective in controlling soil blowing. Overgrazing reduces the protective vegetative cover and lowers the quantity and quality of the native plant community. Proper stocking and a planned grazing system of use and rest help to maintain or improve the native grasses and keep the soil in good condition.

This soil is suited to growing moderately drought resistant trees in windbreaks. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Because of its high shrink-swell potential, this soil cracks in dry seasons, thereby allowing air to dry out roots. Light cultivation after heavy rains can reduce surface cracking, but supplemental water is needed to prevent cracking in the subsoil or to close existing cracks.

Septic tank absorption fields are not suited to this soil because of the slow permeability. Alternate sites can be selected on adjacent, more permeable soils if they are available. Sewage lagoons need to be lined or sealed to prevent seepage. The high shrink-swell potential of the subsoil is a limitation for dwelling and building sites. Foundations and footings should be designed to prevent structural damage caused by the shrinking and swelling of this soil. Low strength, the high shrink-swell potential, and moderate frost action potential are limitations for roads and streets. Strengthening or replacing the base material helps to overcome these limitations.

This soil is in capability units IIs-2, dryland, and IIs-2, irrigated; the Clayey range site; and windbreak suitability group 4L.

Fm—Fillmore silt loam, 0 to 1 percent slopes. This deep, nearly level, poorly drained, claypan soil is in shallow depressions or basins of uplands. Some areas form a ring around lower, wetter soils. Individual areas are oblong, irregular, or circular and range from 5 to 200 acres.

Typically, the surface layer is gray, friable silt loam about 9 inches thick. The subsurface layer is light gray, friable silt loam about 4 inches thick. The subsoil, about 31 inches thick, is gray and grayish brown, very firm silty clay in the upper part and grayish brown, firm silty clay loam in the lower part. The underlying material is grayish brown, calcareous silty clay loam to a depth of 60 inches. In cultivated areas the surface layer has a grayish cast.

Included with this soil in mapping, and making up 15 percent or less of the map unit, are small areas of Butler and Scott soils and small areas of Fillmore, drained, soils. Butler soils are on slightly concave and flat areas in higher positions on the landscape than this Fillmore soil and are better drained. Scott soils are in deeper depressions and are more poorly drained than the Fillmore soil. The drained areas have been filled through land leveling, or ditches were used to carry the excess water to adequate outlets.

Permeability of air and water is very slow in the claypan subsoil of this Fillmore soil. The intake rate is low. The available water capacity is high, but moisture is released slowly to plants. Runoff is ponded for long periods during March through July. The seasonal high water table is near or above the surface. Tilth is good. The shrink-swell potential is moderate in the surface and subsurface layers and high in the subsoil. The organic matter content is moderate, and natural fertility is medium.

About half of the acreage of this soil is farmed. The rest is in native grass and used for grazing, native hay, and as wildlife habitat. Some of the farmed areas are irrigated, but most are not.

If used for dryland farming, this soil is poorly suited to grain sorghum, small grain, and grasses and legumes for hay and pasture. Wheat and alfalfa can not tolerate excess water as well as other crops and are least suitable. Following heavy rains, runoff from adjacent areas saturates the surface layer; and because there are no natural outlets, water ponds for several days or weeks until it evaporates or is slowly absorbed by the soil (fig. 9). This excess water delays tillage and may drown crops. Harvest is often delayed. Terraces on higher adjacent areas slow the runoff onto this soil. Puddling occurs if this soil is tilled when too wet. Upon drying, the soil becomes hard and is difficult to work.

Conservation tillage practices that leave crop residue on the surface help to reduce puddling, conserve soil moisture, and reduce soil blowing. The return of crop residue and green manure crops to the soil and applying barnyard manure increase the organic matter content and reduce crusting. They also improve tilth, fertility, and water intake rate.

If sprinkler irrigated, this soil is poorly suited to corn and grain sorghum. It is generally better suited to the gravity irrigation system. Sprinkler systems can cause ponding, and the center-pivot sprinkler type can stall in wet seasons. Water should be applied at a rate suited to the low water intake rate of this soil in order to prevent ponding.

This soil is suited to use as rangeland or for native hay production. Overgrazing deteriorates the native plant community and reduces the protective vegetation. Grazing or haying when the soil is too wet causes surface compaction. Proper grazing, a planned grazing system of use and rest, and restricted use during wet periods help to maintain or improve the grasses and to keep the soil in good condition. Dugout-type reservoirs

Figure 9.—A ponded area of Fillmore silt loam, 0 to 1 percent slopes, after 2 inches of rain. Ponding delays tillage, planting, and harvesting or can drown crops.

are favorable for providing water for livestock and recreation. The amount of water needed for refill depends on the amount of runoff from higher adjacent areas.

This soil is poorly suited to growing trees in most windbreaks. It is somewhat suited to windbreaks for livestock protection and plantings for wildlife. Only trees and shrubs that are highly tolerant of long periods of ponded water are suited to this soil. The species are identified in Table 8. Tilling the soil and planting the trees in spring may not be possible until the water is absorbed and the soil begins to dry out. Young trees should be protected from grazing by livestock.

The ponding of water for long periods of time causes this soil to be too wet for sanitary facilities and building sites. Sites can be located on higher, adjacent soils that are not subject to ponding. The ponding of water, low strength, and the high frost action potential are limitations for roads and streets. These limitations can be overcome by strengthening or replacing the base material and by building roads on raised, well compacted fill material.

This soil is in capability units IIIw-2, dryland, and IIIw-2, irrigated; the Clayey Overflow range site; and windbreak suitability group 2w.

Fo—Fillmore silt loam, drained, 0 to 1 percent slopes. This deep, nearly level, somewhat poorly drained, claypan soil is on flat divides of the uplands. Areas of this soil were originally poorly and very poorly drained depressions or basins. These areas have been filled through land leveling. Most individual areas are somewhat oblong and range from 5 to 100 acres.

Typically, the surface layer is gray, friable silt loam about 13 inches thick. The subsurface layer is light gray, very friable silt loam about 6 inches thick. The subsoil, about 26 inches thick, is dark gray and gray, very firm silty clay in the upper part and grayish brown, very firm silty clay loam in the lower part. The underlying material is light brownish gray, calcareous silt loam to a depth of 60 inches. In some areas, the surface layer is more than 17 inches thick as a result of fills made during land leveling. In some areas the fill material is lighter colored silty clay loam or silty clay than the typical profile.

Included with this soil in mapping, and making up 15 percent or less of the unit, are small areas of Crete, Butler, and undrained Fillmore soils. Crete soils are moderately well drained and are commonly on slightly higher areas than the Fillmore, drained, soil. Butler soils are on slightly concave, nearly level slopes. The Fillmore soils are in depressional areas and have not been drained as a result of land leveling.

Permeability of air and water is very slow in the claypan subsoil of this Fillmore, drained, soil. The water intake rate is low. The available water capacity is high, but moisture is released slowly to plants. Runoff is slow. After a heavy rainfall, the surface remains saturated for longer periods of time than for the Crete or Hastings soils. The seasonal high water table is at a depth of 1 foot to 3 feet. Tilth is good unless the fill material is taken from the clayey subsoil. The shrink-swell potential is moderate in the surface and subsurface layers and is high in the subsoil. The organic mater content is moderate, and natural fertility is medium.

All areas of this soil are farmed. Nearly all areas are irrigated.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay. Grain sorghum and wheat can tolerate the slow release of moisture from the subsoil best. Also, small grain, such as wheat, matures before the weather becomes hot and dry.

The surface layer of this soil is often saturated in spring, thereby delaying tillage. Puddling and compaction occur if the soil is tilled when it is too wet, especially in areas where the fill material is clayey. After drying, the soil becomes hard and is difficult to work. Tillage should be delayed until the soil moisture content is low enough that compaction and puddling do not occur. Returning crop residue to the soil helps to maintain the organic matter content and fertility level and reduces crusting and compacting. It also improves tilth and the water intake rate.

Including a deep rooted legume, such as alfalfa, in the cropping sequence opens compacted layers and the claypan subsoil for improved water movement as well as improved fertility and tilth. Rotating crops interrupts weed, insect, and disease cycles. Leaving crop stubble standing throughout the winter prevents soil blowing and catches drifting snow for additional soil moisture.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture. Cuts and fills from land leveling with clayey material are difficult to till and to establish seedlings on. Adding zinc and organic matter can improve the fertility and tilth of these areas. The application rate of irrigation water should be based on the water intake rate of the soil in order to reduce runoff. Runoff needs to be conserved by tailwater recovery systems.

This soil is suited to rangeland. Grasses are effective in controlling soil blowing. Overgrazing reduces the protective vegetative cover and lowers the quantity and quality of the native plant community. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and keep the soil in good condition.

This soil is moderately well suited to growing trees in windbreaks. Surface wetness may delay planting in wet years. The soil should be tilled and the trees planted when the soil is dry enough to avoid puddling and compaction. This soil has high shrink-swell potential and cracks in dry seasons, thereby allowing air to dry out seedling roots. Light cultivation after heavy rains can help to prevent surface cracks, but supplemental water is needed to prevent the subsoil from cracking or to close existing cracks.

This soil is not suited to use as building sites or sanitary facilities because of the very slow permeability and the wetness. Alternate sites on soils that are suited to these uses should be considered. Wetness, low strength, and high frost action potential are limitations for roads and streets. Constructing roads on suitable compacted fill and providing adequate side ditches and culverts help to protect roads from wetness.

This soil is in capability units IIw-2, dryland, and IIw-2, irrigated; the Clayey range site; and windbreak suitability group 4L.

GaC—Geary silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is mostly on narrow, convex divides between steep upland drainageways. Some areas are on lower side slopes of the upland breaks to stream terraces. Individual areas are irregular in shape and range from 5 to 30 acres.

Typically, the surface layer is dark grayish brown, very friable silt loam about 9 inches thick. The subsoil is about 33 inches thick. The upper part is dark brown, friable silty clay loam; the middle part is brown, firm silty clay loam; and the lower part is strong brown, friable silty clay loam. The underlying material is reddish yellow, calcareous silty clay loam to a depth of about 60 inches. In cultivated areas, the surface layer is slightly thinner. In a few places the subsoil is exposed at the surface as a result of erosion. Lime is at a depth of less than 40 inches in some profiles.

Included with this soil in mapping, and making up 10 percent or less of the map unit, are small areas of Hastings and Holder soils. Hastings and Holder soils are generally in higher positions on narrow divides and side slopes than this Geary soil.

Permeability is moderately slow, available water capacity is high, and the water intake rate is moderately low in this Geary soil. Runoff is medium. The very friable surface layer is easily tilled. The subsoil has moderate shrink-swell potential. The organic matter content is moderate, and natural fertility is medium.

Most areas of this soil are in native grass and are used for grazing. The rest is used for dryland farming. The native grass areas are mostly between or adjacent to steep drainageways.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay and pasture. It is moderately well suited to corn. Water erosion caused by runoff is the main hazard on this soil. Runoff can be controlled by using terraces, contour farming, and grassed waterways. Conservation tillage practices that leave crop residue on the soil help to reduce water erosion and soil blowing and conserve soil moisture. Leaving crop stubble standing throughout winter helps to catch drifting snow for additional soil moisture and also controls soil blowing. A cropping system that includes close grown crops, such as wheat, alfalfa, or grasses, provides additional erosion control and improves soil tilth and water intake. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve organic matter content, fertility, tilth, and water intake rate.

If irrigated, this soil is suited to grasses and legumes, such as alfalfa. If erosion is controlled, this soil is suited to corn, grain sorghum, and soybeans if irrigated. The sprinkler system is the best method of irrigating this soil. However, adjacent, steep drainageways often limit its use. Contour bench leveling is suited to some of the less sloping areas. Slopes make it difficult to control erosion caused by rainfall and runoff of additional irrigation water. The application rate of irrigation water should be based on the water intake rate of the soil. As a result of irrigation, additional crop residue is available to return to the soil. The same conservation tillage practices that help to control erosion in dryland areas are needed in irrigated areas.

This soil is suited to use as rangeland. Grasses effectively control erosion. Areas on narrow divides between steep drainageways are best suited to range. Overgrazing reduces the protective vegetative cover, deteriorates the native plant community, and increases runoff and soil loss. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and to keep the soil in good condition.

This soil is suited to growing moderately drought resistant trees in windbreaks. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Planting tree rows on the contour and leaving a strip of sod, or planting a cover crop between the rows helps to reduce the erosion hazard. Seedlings may need supplemental water during dry seasons.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields. This limitation can generally be overcome by increasing the size of the absorption area. In sewage lagoon areas, grading is necessary to modify the slope and to shape the lagoon. Lateral seepage from sewage lagoons is also a limitation unless the lagoon is lined or sealed. The moderate shrink-swell potential of the subsoil is a limitation for building sites. Foundations and footings for dwellings and small buildings should be properly designed to prevent structural damage caused by the shrinking and swelling of this soil. The low strength of the subsoil is a limitation for local roads and streets. This limitation can be overcome by strengthening or replacing the base material.

This soil is in capability units IIIe-1, dryland, and IIIe-4, irrigated; the Silty range site; and windbreak suitability group 3.

GaD—Geary silt loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is mostly on narrow, convex divides between steep upland drainageways. Some areas are on sides of upland drainageways. Individual areas are irregular in shape and range from 5 to 20 acres.

Typically, the surface layer is very friable, dark grayish brown silt loam 9 inches thick. The subsoil, about 31 inches thick, is brown, friable silty clay loam in the upper part; brown and light brown, firm silty clay loam in the middle part; and light brown, friable silty clay loam in the lower part. The underlying material is light brown, calcareous silty clay loam to a depth of about 60 inches. In cultivated areas the surface layer is slightly thinner than in the typical profile. In a few places the subsoil is exposed at the surface as a result of erosion. Lime is at a depth of less than 40 inches in some profiles.

Included with this soil in mapping, and making up 15 percent or less of the map unit, are small areas of Holder soils and small areas in which the underlying material is sand and gravel. Holder soils are in higher positions on narrow divides and side slopes than this Geary soil. Areas that have sand and gravel underlying material are on the lower side slopes of this unit.

Permeability is moderately slow, available water capacity is high, and the water intake rate is moderately low in this Geary soil. Runoff is medium or rapid. The very friable surface layer is easily tilled. The subsoil has moderate shrink-swell potential. The organic matter content is moderate, and natural fertility is medium.

Nearly all areas of this soil are in native grass and used for grazing. The rest is used for dryland farming. The native grass areas are commonly between steep drainageways or adjacent to steep slopes.

If used for dryland farming, this soil is poorly suited to corn and grain sorghum. It is better suited to small grain and to legumes and grasses for hay and pasture than to row crops. Corn and grain sorghum should be limited in the cropping sequence.

Sheet and gully erosion are difficult to control if this soil is cultivated and the surface is not protected. Runoff can be controlled by using terraces, contour farming, and grassed waterways. Conservation tillage practices, such as using minimum tillage, help to reduce water erosion and soil blowing and to conserve moisture. Leaving crop stubble and residue on the surface throughout winter catches drifting snow for additional soil moisture and also controls soil blowing. Returning crop residue and green manure crops to the soil and applying barnyard manure help to increase the organic matter content, thereby maintaining good tilth and a good water intake rate. Fertility is also improved.

If irrigated, this soil is poorly suited to close grown crops, such as small grain and legumes and grasses, because of the difficulty in controlling the water. The gravity irrigation system is unsuited to this soil. The conservation practices used in dryland areas can be used to control erosion in irrigated areas.

This soil is suited to use as rangeland. Grasses effectively control erosion. Areas of this soil on narrow divides between steep drainageways are best suited to range. Overgrazing reduces the protective vegetative cover, deteriorates the native plant community, and increases runoff and soil loss. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and keep the soil in good condition.

This soil is suited to growing moderately drought resistant trees in windbreaks. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Growth may be slower on this Geary soil than on less sloping soils. Planting tree rows on the contour and leaving a strip of sod, or planting a cover crop between the rows helps to reduce the erosion hazard. Seedlings may need supplemental water during dry seasons.

The steepness of slope and moderately slow permeability of this soil are limitations for septic tank absorption fields. The moderately slow permeability can be overcome by increasing the size of the absorption area. Septic tank absorption fields should be constructed on the contour after grading. In some areas, seepage of effluent into the underlying sand and gravel is a hazard. For sewage lagoons, extensive grading is necessary to modify the slope and to shape the lagoon. Adjacent, less sloping soils are better sites for sewage lagoons and septic tank absorption fields.

The steepness of slope and the moderate shrink-swell potential of the subsoil are limitations for building sites. Foundations and footings for dwellings and small buildings should be designed to prevent structural damage caused by the shrinking and swelling of this soil. Dwellings and buildings need to be properly designed to accommodate the slope, or the soil can be graded. Diversions and special installations are needed to divert runoff away from building sites. Low strength is a limitation for local roads and streets. This limitation can be overcome by strengthening or replacing the base material.

This soil is in capability units IVe-1, dryland, and IVe-4, irrigated; the Silty range site; and windbreak suitability group 4.

GaF—Geary-Hobbs silt loams, 0 to 30 percent slopes. This map unit consists of deep, somewhat excessively drained, steep soils on uplands and deep, nearly level and very gently sloping, well drained soils on bottom lands along intermittent streams. Individual areas range from 5 to 120 acres. This map unit is 50 to 70 percent Geary soil and 30 to 50 percent Hobbs soil. The Geary soil is on the sides of upland drainageways. The Hobbs soil is on the bottoms of narrow, channeled drainageways. It is occasionally flooded. Areas of the two soils are so narrow and long that it was not practical to map them separately.

Typically, the Geary soil has a surface layer that is grayish brown, very friable silt loam about 6 inches thick. The subsoil, about 35 inches thick, is silty clay loam. It is brown and friable in the upper part, brown and firm in the middle part, and reddish yellow and friable in the lower part. The underlying material is reddish yellow, calcareous silty clay loam to a depth of 60 inches. The lighter colored material of the subsoil is exposed at the surface on small eroded areas that have been overgrazed or cultivated and on eroded catsteps.

Typically, the Hobbs soil has a stratified surface layer that is grayish brown and light brownish gray, very friable silt loam about 6 inches thick. The underlying material to a depth of 60 inches is stratified, pale brown and brown silt loam in the upper part; grayish brown and light brownish gray silty clay loam in the middle part; and light yellowish brown silt loam in the lower part. In some areas the surface layer is fine sandy loam or silty clay loam.

Included with these soils in mapping, and making up 20 percent or less of the map unit, are small areas of Holder and Uly soils and outcrops of sand and gravel. Uly soils are on the short, steep sides of drainageways mostly at higher elevations than the Geary soil. Holder soils are on gently sloping to strongly sloping sides of drainageways. The sand and gravel outcrops are on the lower-lying parts of mapped areas.

Permeability is moderately slow in the Geary soil and moderate in the Hobbs soil. The available water capacity is high, and moisture is released readily to plants. Runoff is rapid on the Geary soil and slow on the Hobbs soil. Tilth is good. The organic matter content is moderately low in the Geary soil and moderate in the Hobbs soil. Natural fertility is medium in the Geary soil and high in the Hobbs soil. The shrink-swell potential is moderate in the Geary soil and low in the Hobbs soil.

Nearly all areas of these soils are in native grass and are used for grazing or hay. A few areas are farmed.

The soils in this map unit are unsuited to dryfarming and to irrigation because of the steep slopes and the severe hazard of erosion. The few cultivated areas should be reseeded to a mixture of native grass. Introduced grasses for pasture are not well suited to the Geary soil because they usually provide less vegetative cover to protect against erosion. A few of the less sloping areas are suited to native hay.

These soils are suited to use as rangeland. Overgrazing reduces the protective vegetative cover, thereby increasing the hazard of erosion, especially on the steep slopes. Leaving about half of the grass cover at all times maintains the vegetation, slows the runoff, and protects the soil. The correct placement of fences, livestock watering developments, and salting facilities can insure the proper distribution of livestock. Reseeding or interseeding may be needed where the native plant community has deteriorated.

Occasional flooding on the bottom land areas causes sedimentation and introduces weeds. Weeds should be controlled so that the desirable grasses can be reestablished. Earth dams and excavated ponds can be installed to provide water for livestock, irrigation, and recreation, as well as to control runoff. Conservation land treatment measures should be applied to areas above these structures to prevent sediment from limiting their period of use.

The soils in this map unit are unsuited to growing trees in windbreaks. Tree planting with machinery is difficult and can cause erosion on the steep slopes and on the narrow, possibly gullied bottom lands.

The soils in this map unit have either excessive slopes or are occasionally flooded. These limitations make the soils generally unsuited to septic tank absorption fields, sewage lagoons, and dwelling and building sites. Extensive cuts and fills on the steep slopes are needed to provide a suitable grade for local roads. On the narrow flood plains, roads need to be constructed on suitable compacted fill material, and adequate side ditches and culverts are needed to protect roads from flood damage. Low strength is a limitation for roads, but this limitation can be overcome by strengthening or replacing the base material. Road cuts should be seeded to protective vegetative cover to prevent erosion.

This map unit is in capability unit VIe-1, dryland. The Geary soil is in the Silty range site and windbreak suitability group 10. The Hobbs soil is in the Silty Overflow range site and windbreak suitability group 1.

GeC2—Geary silty clay loam, 3 to 6 percent slopes, eroded. This deep, gently sloping, well drained soil is on lower side slopes of upland breaks to stream terraces and upland drainageways. Rills and small gullies are common on this eroded soil. Individual areas are irregular in shape and range from 5 to 30 acres.

Typically, the surface layer is brown, firm silty clay loam about 7 inches thick. The subsoil is about 24 inches thick. The upper part of the subsoil is brown, firm silty clay loam; and the lower part is reddish yellow, friable silty clay loam. The underlying material is reddish yellow, calcareous silty clay loam to a depth of about 60 inches. In most areas, erosion has removed some or all of the original dark surface layer and, in places, part of the subsoil. Most areas have lime at depths of less than 40 inches, and in some areas it is at the surface.

Included with this soil in mapping, and making up less than 10 percent of the unit, are small eroded areas of Hastings and Holder soils. These soils generally are on the upper part of side slopes.

Permeability in this Geary soil is moderately slow, the available water capacity is high, and the water intake rate is low. Runoff is medium. Reaction in the surface layer ranges from slightly acid to mildly alkaline, depending on the extent of erosion. The natural fertility and organic matter content are low because of the loss of the original dark surface layer by erosion. The available phosphorus level is low. The low organic matter content and silty clay loam surface layer make this soil difficult to till. The shrink-swell potential is moderate.

Nearly all areas of this soil are used for dryland farming. A few areas that are generally adjacent to steep slopes have been reseeded to native grass.

This soil is suited to small grain and grain sorghum and to grasses and legumes for hay and pasture if dryland farming is used. The soil is moderately well suited to corn. The main hazard is water erosion caused by runoff. Terraces, contour farming, and grassed waterways reduce runoff. Conservation tillage practices that include leaving crop residue on the soil help to control water erosion and soil blowing and to conserve soil moisture. Crop stubble left standing on the soil throughout winter catches drifting snow for additional soil moisture and also helps to control soil blowing.

This soil has a low water intake rate. Water puddles after hard rains. If the soil is worked when it is too wet, it becomes hard when dry. A cropping system that includes close grown crops most of the time, such as wheat, alfalfa, or grasses, improves soil tilth and the water intake rate. It also helps control erosion. Returning crop residue and green manure crops to the soil and applying barnyard manure help to increase the organic matter content, to provide better tilth and water intake rate, and also help to increase fertility. Phosphorous fertilizer is needed for good alfalfa production.

If irrigated, this soil is suited to grasses and alfalfa. If erosion is controlled, the soil is also suited to corn, grain sorghum, and soybeans. Sprinkler irrigation is better for this soil than other methods of irrigation. Contour bench leveling can be used on some of the less sloping areas. The slopes make it difficult to control erosion caused by rainfall and additional irrigation water. Rates of water application should be based on the water intake rate of this soil. Conservation practices used on dryland can also be used if this soil is irrigated. Leaving crop residue on the soil increases water intake, conserves moisture, and improves soil tilth.

This soil is suited to use as rangeland. Grasses greatly reduce the hazard of erosion. Overgrazing reduces the protective plant cover, deteriorates the native plant community, and increases runoff and soil losses. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper grazing, a planned grazing system of use and rest, and restricted use during wet periods help to maintain or improve the native grasses and keep soil in good condition.

If this soil is used for windbreaks, it is suited to trees that tolerate moderate droughtiness. If competing vegetation is controlled or removed by using good site preparation and timely cultivation, the seedlings generally survive. Planting tree rows on the contour and planting a cover crop between the rows help to reduce the erosion hazard. Seedlings may need supplemental water during dry seasons.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields. This limitation can generally be overcome by increasing the size of the absorption area. For sewage lagoon areas, grading is needed to modify the slope and shape the lagoon. Lateral seepage from sewage lagoons is also a limitation unless the lagoon is lined or sealed. The moderate shrink-swell potential is a limitation for building sites. Foundations and footings for dwellings and small buildings should be designed to prevent structural damage caused by the shrinking and swelling of the soil. Low strength is a limitation for local roads and streets. This can be overcome by strengthening or replacing the base material.

This soil is assigned to capability units IIIe-8, dryland, and IIIe-3, irrigated; the Silty range site; and windbreak suitability group 3.

GeD2—Geary silty clay loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well drained soil is on lower side slopes of upland breaks to stream terraces and upland drainageways. Small gullies are common on this eroded soil. Individual areas are irregular in shape and range from 5 to 80 acres.

Typically, the surface layer is firm, brown silty clay loam about 6 inches thick. The subsoil is about 21 inches thick. It is brown, firm silty clay loam in the upper part and light brown, friable silty clay loam in the lower part. The underlying material is light brown, calcareous silty clay loam to a depth of about 60 inches. In most areas, erosion has removed all of the original, dark silt loam surface layer and, in places, part of the subsoil. In many places the underlying material is exposed at the surface as a result of erosion. Most profiles have lime at a depth of less than 40 inches, and some have it at the surface.

Included with this soil in mapping, and making up 15 percent or less of the map unit, are small areas of Hobbs soils and eroded Holder soils, outcrops of sand and gravel, and a soil that has sand at a depth of 20 to 40 inches. The Holder soils are generally on the upper part of side slopes. The Hobbs soils are on the bottoms of drainageways. Outcrops of sand and gravel are in lower positions on the landscape than this Geary soil. A soil that has sand at a depth of 20 to 40 inches is between the Geary soil and the outcrops of sand and gravel.

Permeability is moderately slow, available water capacity is high, and the water intake rate is low in this Geary soil. Runoff is medium to rapid. Reaction in the surface layer is neutral or mildly alkaline depending on the extent of erosion. Natural fertility and organic matter content are low because of the loss of surface soil by erosion. The available phosphorus is especially deficient. The low organic matter content and silty clay loam surface layer make this soil difficult to till. This soil has moderate shrink-swell potential.

Most areas of this soil are used for dryland farming. A few areas are irrigated. Some areas have been reseeded to native grass and are generally adjacent to steep slopes.

If used for dryland farming, this soil is poorly suited to corn and grain sorghum. It is better suited to small grain and legumes and grasses for hay and pasture than to row crops. Sheet and gully erosion are difficult to control if this soil is cultivated. Corn and grain sorghum should be limited in the cropping sequence.

Terraces, contour farming, and grassed waterways reduce runoff (fig. 10). Conservation tillage practices that leave crop residue on the surface help to control water erosion and soil blowing and to conserve soil moisture. Crop stubble standing throughout winter catches drifting snow for additional soil moisture and also controls soil blowing. This soil has a low water intake rate, becomes puddled after hard rains or if worked when it is too wet, and becomes hard when dry. Returning crop residue and green manure crops to the soil and applying barnyard manure help to increase the organic matter content, thereby improving tilth and the water intake rate. Natural fertility is also increased. Phosphorous fertilizer is needed for good alfalfa production.

If irrigated, this soil is better suited to close grown crops, such as small grain and legumes and grasses, because of the difficulty in controlling the flow of water. Adjacent, steep slopes often limit the use of a sprinkler system. Application rates of irrigation water should be based on the water intake rate of this soil. Additional crop residue is available as a result of irrigation. Leaving crop residue on the surface helps to conserve moisture, improve tilth, and increase the water intake rate.

This soil is suited to use as rangeland. Grasses help to reduce the hazard of erosion. Overgrazing reduces the protective vegetative cover, deteriorates the native plant community, and increases runoff and soil loss. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper grazing, a planned grazing system of use and rest, and restricted use during wet periods keep the grasses and soil in good condition. Earth dams can be constructed on drainageways to intercept runoff for livestock water.

If this soil is used for windbreaks, it is suited to growing trees that tolerate moderate droughts. If competing vegetation is controlled or removed, seedlings generally survive. Planting tree rows on the contour, using terraces, and planting a cover crop between the rows help to reduce the erosion hazard. Seedlings may need supplemental water during dry seasons.

The steepness of slope and moderately slow permeability of this soil are limitations for septic tank absorption fields. The moderately slow permeability can be overcome by increasing the size of the absorption area. Septic tank absorption fields should be constructed on the contour after grading. In some areas, seepage of effluent into the underlying sand and gravel is a hazard. For sewage lagoons, extensive grading is necessary to modify the slope and to shape the lagoon. Adjacent, less sloping soils are better sites for sewage lagoons and septic tank absorption fields.

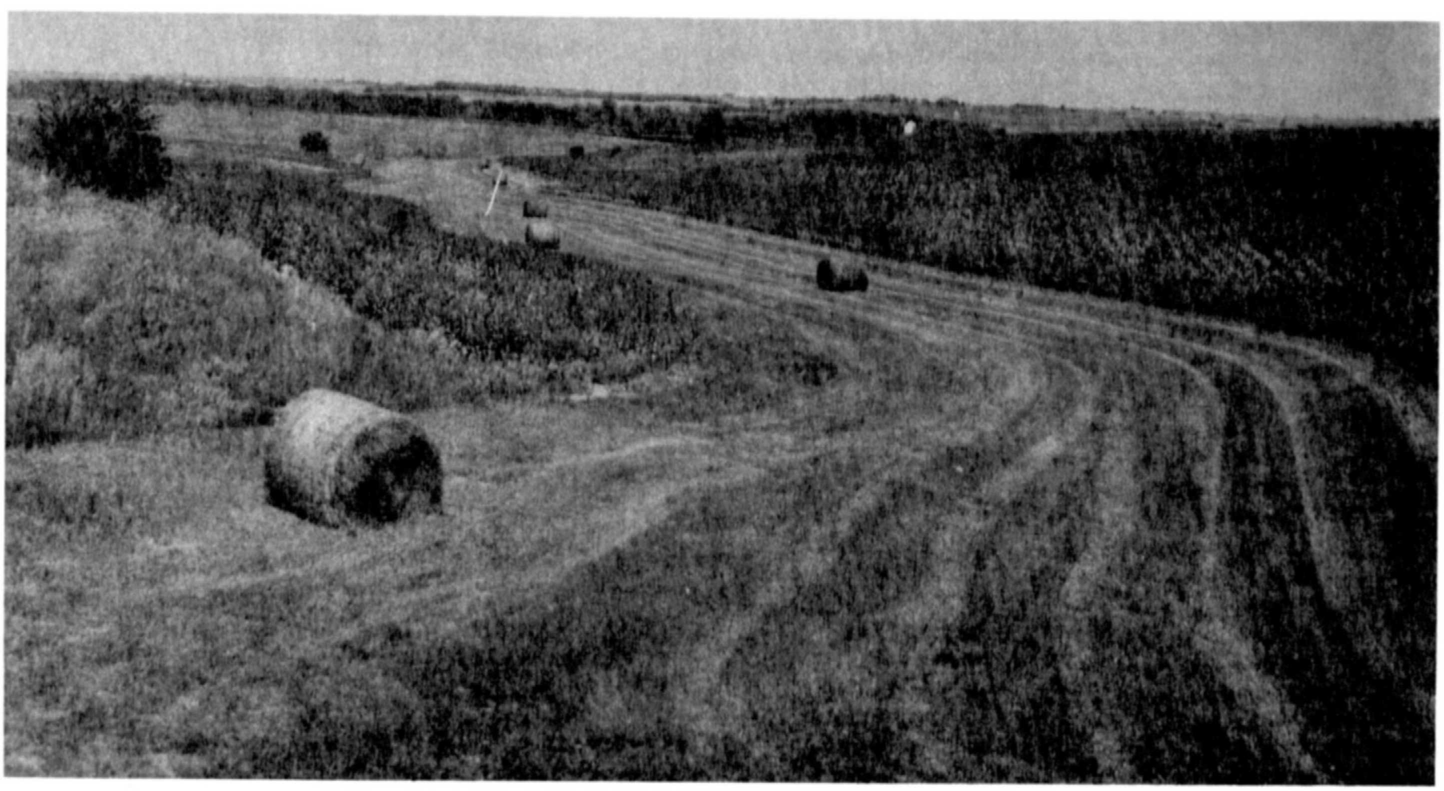

Figure 10.—A grassed waterway planted to native grass on Geary silty clay loam, 6 to 11 percent slopes, eroded, controls runoff from dryland fields of grain sorghum and provides a native hay crop.

The steepness of slope and the moderate shrink-swell potential of the subsoil are limitations for building sites. Foundations and footings for dwellings and small buildings should be designed to prevent structural damage caused by the shrinking and swelling of this soil. Dwellings and buildings should be properly designed to accommodate the slope, or the soil can be graded. Diversions and special installations are needed to divert runoff away from building sites. Low strength is a limitation for local roads and streets. This limitation can be overcome by strengthening or replacing the base material.

This soil is in capability units IVe-8, dryland, and IVe-3, irrigated; the Silty range site; and windbreak suitability group 3.

GeE2—Geary silty clay loam, 11 to 17 percent slopes, eroded. This deep, steep, somewhat excessively drained soil is on the short, moderately steep sides of upland drainageways. Rills and gullies are common on this eroded soil. Individual areas range from 5 to 60 acres.

Typically, the surface layer is brown, firm silty clay loam about 3 inches thick. The subsoil is about 9 inches thick. It is light brown, firm silty clay loam. The underlying material is light brown, pink, and pinkish gray, calcareous silty clay loam to a depth of 60 inches. In most areas, erosion has removed all of the original dark surface layer and most of the subsoil.

Included with this soil in mapping, and making up 20 percent or less of the map unit, are small areas of eroded Holder and Uly soils and outcrops of sand and gravel. Uly soils are on the short, moderately steep and steep sides of drainageways at slightly higher elevations than the Geary soil. Holder soils are on gently sloping to strongly sloping sides of drainageways. The sand and gravel outcrops are on the lower-lying parts of mapped areas.

Permeability is moderately slow, available water capacity is high, and moisture is released readily to plants in this Geary soil. Runoff is rapid. Tilth is poor as a result of the low organic matter content, and natural fertility is low. The shrink-swell potential is moderate.

Nearly all areas of this soil are farmed. A few areas have been reseeded to native or tame grasses and are used for grazing or hay.

This soil is generally unsuited to dryland farming and to irrigation because of the steep slopes and the severe hazard of erosion. The cultivated areas need to be reseeded to native grass. Introduced grasses for pasture are somewhat unsuited to this soil because they usually need a higher level of fertility to produce enough vegetative cover to prevent erosion. A few of the less sloping areas are suited to native hay.

This soil is suited to use as rangeland. Overgrazing reduces the protective vegetative cover and results in erosion. Leaving about half of the grass cover ungrazed maintains the vegetation, slows the runoff, and protects the soil. The correct placement of fences, livestock water developments, and salting facilities in pastures can insure the proper distribution of livestock. Earth dams and excavated ponds can be installed to provide water for livestock and recreation, as well as to control runoff. Conservation land treatment measures should be applied to areas above these structures to prevent sediment from limiting their period of use.

This soil is poorly suited to growing trees in windbreaks. Tree planting with machinery is difficult on the moderately steep slopes.

Excessive slopes limit the use of this soil for septic tank absorption fields and sewage lagoons. More suitable sites may be located on adjacent, less sloping areas. The slopes and moderate shrink-swell potential are limitations for dwelling and building sites. Foundations and footings for dwellings and small commercial buildings should be designed to prevent structural damage due to the shrinking and swelling of the soil. Dwellings and buildings need to be properly designed to accommodate the slope, or the soil can be graded. Cuts and fills are needed in places to provide a suitable grade for roads. Road cuts should be seeded to provide a protective vegetative cover. Adequate culverts and bridges need to be provided to prevent damage from excessive runoff. Low strength is a limitation for local roads and streets. This limitation can be overcome by strengthening or replacing the base material.

This soil is in capability unit VIe-8, dryland; the Silty range site; and windbreak suitability group 3.

Ha—Hall silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on nearly flat uplands. Individual areas are irregular in shape and range from 5 to 1,000 acres. Most areas are more than 500 acres.

Typically, the surface layer is grayish brown and dark grayish brown, very friable silt loam about 13 inches thick. The subsoil, about 31 inches thick, is dark grayish brown, friable silty clay loam in the upper part; dark grayish brown and brown, firm silty clay loam in the middle part; and pale brown, friable silty clay loam in the lower part. The underlying material to a depth of 60 inches is very pale brown silt loam. The surface layer is neutral in reaction in some areas. In some areas, this soil is not dark to a depth of 20 inches, and in some areas the subsoil is more than 35 percent clay.

Included with this soil in mapping, and making up 10 percent or less of the map unit, are small areas of Butler and Fillmore soils. Butler soils are in slightly concave, somewhat poorly drained areas. Fillmore soils are in poorly drained depressions. Some depressions have been filled land leveling.

Permeability is moderate, and available water capacity is high in this Hall soil. Moisture is released readily to plants, and the water intake rate is moderately low. Runoff is slow. Tilth is good in the surface layer. The organic matter content is moderate, and natural fertility is high. The shrink-swell potential is moderate in the surface layer and subsoil.

Most areas of this soil are used for dryland farming because they do not have available ground water for irrigation. Other areas are in native grass and are generally adjacent to or between steep drainageways.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay and pasture. Soil blowing is a hazard if this soil is cultivated. Conservation tillage practices that leave crop residue on the surface help to prevent soil blowing and also conserve soil moisture. Summer fallowing can conserve moisture and increase crop yields. Crop stubble left standing throughout winter catches drifting snow for additional soil moisture and also prevents soil blowing. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve the organic matter content, fertility, tilth, and water intake rate. Rotating crops improves tilth and the water intake rate and interrupts weed, insect, and plant disease cycles.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture. Land leveling improves surface drainage and allows for uniform distribution of water in the gravity irrigation system. Deep cuts need additions of organic matter and zinc to improve tilth and fertility. Irrigation water can be conserved by applying it at a rate suited to the moderately low water intake rate of this soil. If the gravity irrigation system is used, a tailwater recovery system is needed to conserve runoff of irrigation water and to improve the efficiency of the system.

This soil is suited to use as rangeland. Grasses effectively control soil blowing. Overgrazing reduces the protective vegetation and lowers the quantity and quality of the native plant community. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and to keep the soil in good condition.

This soil is suited to growing moderately drought resistant trees in windbreaks. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Seedlings may need supplemental water during dry seasons.

This soil is suited to use as building sites and sanitary facilities. Moderate permeability is a limitation for septic tank absorption fields, but this limitation can be overcome by increasing the size of the absorption area. Sewage lagoons need to be lined or sealed to prevent seepage. The moderate shrink-swell potential is a limitation for dwelling and building sites. Proper design of foundations and footings can prevent structural damage caused by the shrinking and swelling of this soil. Low strength is a limitation for roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is in capability units I-1, dryland, and I-4 irrigated; the Silty range site; and windbreak suitability group 3.

Hc—Hastings silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on flat and slightly convex uplands. Individual areas are mostly broad and irregular in shape and range from 5 to 1,000 acres.

Typically, the surface layer is dark grayish brown, very friable silt loam about 10 inches thick. The subsoil is about 28 inches thick. It is dark grayish brown, friable silty clay loam in the upper part; brown, firm silty clay loam in the middle part; and pale brown, friable silty clay loam in the lower part. The underlying material is pale brown, calcareous silt loam to a depth of about 60 inches. In some areas the surface layer is less than 5 inches thick or more than 14 inches thick as a result of cuts and fills made during land leveling. The surface layer is neutral in reaction in some areas. This soil is dark to a depth of more than 20 inches in some pedons.

Included with this soil in mapping, and making up 15 percent or less of the map unit, are small areas of Crete, Butler, and Fillmore soils and areas in which the lighter colored subsoil or underlying material is exposed at the surface as a result of land leveling. Crete and Butler soils are in slightly lower positions on the landscape and are more poorly drained than this Hastings soil. The Fillmore soils are in depressions unless the depressions are filled during land leveling.

Permeability is moderately slow, and available water capacity is high in this Hastings soil. Moisture is released readily to plants, and the water intake rate is moderately low. Runoff is slow. Tilth is good in the surface layer. The organic matter content is moderate, and natural fertility is high. Where deep cuts have been made during land leveling, however, organic matter content is low, tilth is poor, and available zinc is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Most areas of this soil are farmed. Most farmed areas are irrigated, but a few are not. Other areas are in native grass and are adjacent to or between steep drainageways in places.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay and pasture. It is moderately well suited to corn. Soil blowing is a hazard if this soil is cultivated. Conservation tillage practices that leave crop residue on the surface help to control soil blowing and to conserve soil moisture. Summer fallowing can be used to conserve moisture. Crop stubble left standing throughout winter catches drifting snow for additional soil moisture and also reduces soil blowing. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve organic matter content, fertility, tilth, and the water intake rate. Rotating crops improves tilth and the water intake rate and interrupts weed, insect, and plant disease cycles. Including nitrogen-fixing crops, such as alfalfa, in the cropping sequence helps to improve fertility.

If irrigated, this soil is suited to corn (fig. 11), grain sorghum, soybeans, and grasses and legumes for hay

Figure 11.—Furrow irrigation of corn using gated pipe on Hastings silt loam, 0 to 1 percent slopes.

and pasture. Land leveling improves surface drainage and uniform distribution of water in the gravity irrigation system. Leveled areas that have an exposed subsoil need additions of organic matter and zinc to improve the tilth and fertility. Irrigation water can be conserved if the application rate is based on the moderately low water intake rate of this soil. If the gravity irrigation system is used, the tailwater recovery system is needed to conserve runoff of irrigation water.

This soil is suited to rangeland. Grasses effectively control soil blowing. Overgrazing reduces the protective vegetation and lowers the quantity and quality of the native plant community. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and keep the soil in good condition.

This soil is suited to growing moderately drought resistant trees in windbreaks. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Seedlings may need supplemental water during dry seasons.

The moderately slow permeability of the subsoil is a limitation for septic tank absorption fields. This limitation can generally be overcome by increasing the size of the absorption area. Seepage through the moderately permeable underlying material is a limitation for sewage lagoons. This limitation can be overcome if the bottom of the lagoon is properly compacted or sealed. Because the high shrink-swell potential of the subsoil is a limitation for dwelling and building sites, foundations and footings should be designed to prevent structural damage caused by the shrinking and swelling of this soil. The high shrink-swell potential and low strength are limitations for local roads and streets. These limitations can be overcome by strengthening or replacing the base material.

This soil is in capability units I-1, dryland, and I-4, irrigated; the Silty range site; and windbreak suitability group 3.

HcB—Hastings silt loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is on very low knolls and on the sides of drainageways on uplands. Individual areas are somewhat oblong or irregular in shape and range from 5 to about 300 acres.

Typically, the surface layer is grayish brown, very friable silt loam about 8 inches thick. The subsoil, about 27 inches thick, is dark grayish brown, friable silty clay loam in the upper part; brown and pale brown, firm silty clay loam in the middle part; and pale brown, friable silty clay loam in the lower part. The underlying material is light yellowish brown silt loam to a depth of about 60 inches. In some cultivated areas, the surface layer is slightly thinner, and in places it is mixed with material from the subsoil by plowing.

Included with this soil in mapping, and making up 15 percent or less of the unit, are small areas of Crete, Hobbs, and Hord soils; severely eroded soils; and soils in which the subsoil has been exposed by land leveling. The Crete soils are in positions similar to this Hastings soil and in less sloping positions and are moderately well drained. The Hobbs soils are on the bottoms of drainageways, and the Hord soils are on colluvial foot slopes of uplands and terraces. The deeply cut and severely eroded areas are lighter in color because the subsoil or underlying material is exposed at the surface.

Permeability of this Hastings soil is moderately slow, and available water capacity is high. Moisture is released readily to plants, and the water intake rate is moderately low. Runoff is medium. The surface layer has moderate organic matter content, high natural fertility, and good tilth. The organic matter content is low, tilth is poor, and available zinc and phosphorus are deficient in areas where deep cuts have been made during land leveling and on severely eroded areas. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Most areas of this soil are farmed, and the rest is in native grasses. Most of the farmed areas are irrigated, but some are used for dryland farming. The native grass areas generally are adjacent to drainageways or steep slopes. If used for dryland farming, this soil is suited to small grain, grain sorghum, and corn and to grasses and legumes for hay and pasture (fig. 12).

Water erosion can be controlled by use of terraces, contour farming, and grassed waterways. Conservation tillage practices that leave residue on the soil surface help to control water erosion and soil blowing and to conserve soil moisture. Crop stubble left standing throughout winter catches drifting snow for additional soil moisture and reduces soil blowing. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve the organic matter content, fertility, tilth, and water intake rate. Severely eroded areas especially need additional organic matter and phosphorous fertilizer. Including nitrogen-fixing crops, such as alfalfa, in the cropping sequence helps to improve fertility.

If irrigated, this soil is suited to corn, grain sorghum, and soybeans, and to grasses and legumes for hay and pasture. Contour bench leveling can be used to control water erosion and a tailwater recovery system is needed to conserve runoff of irrigation water if gravity irrigation is used. Deep cuts made during land leveling and severely eroded areas need additions of organic matter and applications of zinc and phosphorous fertilizers to improve tilth and fertility. The application of irrigation water should be based on the moderately low water intake rate of this soil to help reduce runoff.

This soil is suited to use as rangeland. Grasses effectively control erosion. Overgrazing reduces the protective plant cover, deteriorates the native plant community, and increases runoff and water erosion. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and keep the soil in good condition.

If this soil is used for windbreaks, it is suited to moderately drought resistant trees. Where feasible, trees can be planted on the contour to prevent water erosion. If competing vegetation is controlled or removed by using good site preparation and timely cultivation, the seedlings usually survive. Seedlings may need supplemental water during dry seasons.

The moderately slow permeability of the subsoil is a limitation for septic tank absorption fields. Increasing the size of the absorption area helps to overcome this limitation. Seepage through the moderately permeable underlying material is a limitation for sewage lagoons. This limitation can be overcome if the floor is properly compacted or sealed. Grading is needed in places to modify the slope and to shape the lagoon. The high shrink-swell potential of the subsoil is a limitation for dwelling and building sites. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling. The high shrink-swell potential and low soil strength are limitations for local roads and streets. This limitation can be overcome by strengthening or replacing the base material.

This soil is in capability units IIe-1, dryland, and IIe-4, irrigated; the Silty range site; and windbreak suitability group 3.

Figure 12.—Dryland grain sorghum and summer fallow that has been planted to wheat on Hastings silt loam, 1 to 3 percent slopes.

HcC—Hastings silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is mostly on convex upland slopes and on sides of upland drainageways. Some areas are on narrow, convex divides between steep upland drainageways and on side slopes of upland breaks to stream terraces. Individual areas are somewhat oblong or irregular in shape and range from 5 to about 200 acres.

Typically, the surface layer is grayish brown, very friable silt loam about 8 inches thick. The subsoil is about 27 inches thick. It is brown, friable silty clay loam in the upper part; light brownish gray, firm silty clay loam in the middle part; and light brownish gray, friable silty clay loam in the lower part. The underlying material is light brownish gray silt loam to a depth of about 60 inches. In some cultivated areas, the surface layer is less than 8 inches thick and, in places, mixed with material from the subsoil by plowing.

Included with this soil in mapping, and making up 10 percent or less of the map unit, are small areas of Geary, Hobbs, and Hord soils and small eroded areas in which lighter colored subsoil or underlying material is exposed at the surface. The Geary soils are in lower positions on side slopes than this Hastings soil. Hobbs soils are on the bottoms of drainageways. Hord soils are on foot slopes.

Permeability is moderately slow, and available water capacity is high in this Hastings soil. Moisture is released readily to plants, and the water intake rate is moderately low. Runoff is medium. Tilth is good in the friable surface layer. The organic matter content is moderate, and natural fertility is high. In the eroded areas, however, tilth is poor, organic matter content is low, and available phosphorus is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

About half of the acreage of this soil is farmed. The rest is in native grass. About half of the farmed areas are irrigated. The native grass areas are mostly adjacent to or between steep drainageways.

If used for dryland farming, this soil is suited to growing small grain, grain sorghum, and grasses and legumes for hay and pasture. It is somewhat suited to corn. Water erosion caused by runoff is the main hazard on this soil. Runoff can be controlled by terraces, contour farming, and grassed waterways. Conservation tillage practices that leave crop residue on the soil help to reduce water erosion and soil blowing and conserve moisture. Leaving crop stubble standing throughout winter helps to catch drifting snow for additional soil moisture and also controls soil blowing. A cropping system that includes close grown crops, such as wheat, alfalfa, or grasses, provides additional erosion control and improves soil tilth and water intake. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve organic matter content, fertility, tilth, and the water intake rate. Additional phosphorus needs to be added in the eroded areas.

If irrigated, this soil is suited to grasses and such legumes as alfalfa. If erosion is controlled, this soil is also suited to corn, grain sorghum, and soybeans. The sprinkler system is the best method of irrigating this soil. Contour bench leveling and using gravity irrigation are suited to some of the less sloping areas. The slope makes it difficult to control erosion caused by rainfall and runoff of additional irrigation water. The conservation tillage practices used in dryland areas can also be used in irrigated areas. Terraces present few problems for center-pivot sprinkler systems and aid in intercepting runoff to prevent erosion along wheel tracks. Terraces should be kept in grass so that the depth of wheel tracks is kept to a miminum. Additional crop residue is available when the soil is irrigated. If it is left on the surface of the irrigated areas, crop residue helps to control erosion. Application of irrigation water should be based on the moderately low water intake rate of the soil.

This soil is suited to use as rangeland. Grasses effectively control erosion. Areas of this soil on narrow divides between steep drainageways are best suited to range. Overgrazing reduces the protective vegetative cover, lowers the quantity and quality of the native plant community, and increases runoff and soil loss. A planned grazing system of use and rest and proper grazing help to maintain or improve the native grasses and keep the soil in good condition.

This soil is suited to growing moderately drought resistant trees in windbreaks. If competing vegetation is controlled or removed through good site preparation and timely cultivation, seedlings generally survive. Planting tree rows on the contour and leaving strips of sod, or planting a cover crop between the rows helps to reduce the hazard of erosion. Seedlings may need supplemental water during dry seasons.

The moderately slow permeability of the subsoil is a limitation for septic tank absorption fields. This limitation can generally be overcome by increasing the size of the absorption area. For sewage lagoons, grading is necessary to modify the slope and to shape the lagoon. Lateral seepage of effluent from sewage lagoons is also a limitation. This limitation can be overcome by sealing or lining the lagoon. The high shrink-swell potential of the subsoil is a limitation for dwelling and building sites. Foundations and footings for dwellings and small buildings should be designed to prevent structural damage caused by shrinking and swelling of this soil. The high shrink-swell potential and low strength are severe limitations for local roads and streets. These limitations can be overcome by strengthening or replacing the base material.

This soil is in capability units IIIe-1, dryland, and IIIe-4, irrigated; the Silty range site; and windbreak suitability group 3.

HdC2—Hastings silty clay loam, 3 to 6 percent slopes, eroded. This deep, gently sloping, well drained soil is on short sides of upland drainageways and on convex upland slopes. Some areas are on side slopes of upland breaks to stream terraces. A few areas are on the sides of drainageways crossing terraces. Rills and small gullies are common on this eroded soil. Individual areas are somewhat oblong and irregular in shape and range from 5 to about 150 acres.

Typically, the surface layer is grayish brown, friable silty clay loam about 7 inches thick. The subsoil is about 24 inches thick. The upper part is dark grayish brown and grayish brown, firm silty clay loam; and the lower part is light brownish gray, friable silty clay loam. The underlying material is light gray and light brownish gray silt loam to a depth of about 60 inches. In most areas, erosion has removed some to all of the original, dark surface layer and, in places, part of the subsoil. In a few places the underlying material is exposed at the surface as a result of erosion or deep cuts made during land leveling. Some areas have lime at a depth of less than 36 inches, and in some areas lime is at the surface.

Included with this soil in mapping, and making up 10 percent or less of the map unit, are small areas of Geary, eroded; Hobbs; and Hord soils. Geary soils are in lower positions on the sides of upland drainageways than this Hastings soil. Hobbs soils are on the bottoms of drainageways, and Hord soils are on the less sloping foot slopes.

Permeability is moderately slow, and available water capacity is high in this Hastings soil. Moisture is released readily to plants, and the water intake rate is low. Runoff is medium. Natural fertility and organic matter content are low because of the loss of the surface layer by erosion. Available phosphorus and zinc are deficient in deep cuts made during land leveling. Tilth is poor because of the low organic matter content and silty clay loam surface layer. The shrink-swell potential is high. Reaction in the surface layer ranges from slightly acid to mildly alkaline, depending on the extent of erosion.

Nearly all areas of this soil are farmed. About half of the farmed areas are irrigated. A few areas, which are generally adjacent to wetlands or steep drainageways, have been reseeded to native grass.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay and pasture. Water erosion caused by runoff is the main hazard of this soil. Terraces, contour farming, and grassed waterways reduce runoff (fig. 13). Conservation tillage practices that leave crop residue on the soil control water erosion and soil blowing and conserve soil moisture. Crop stubble left standing throughout winter catches drifting snow for additional soil moisture and also controls soil blowing.

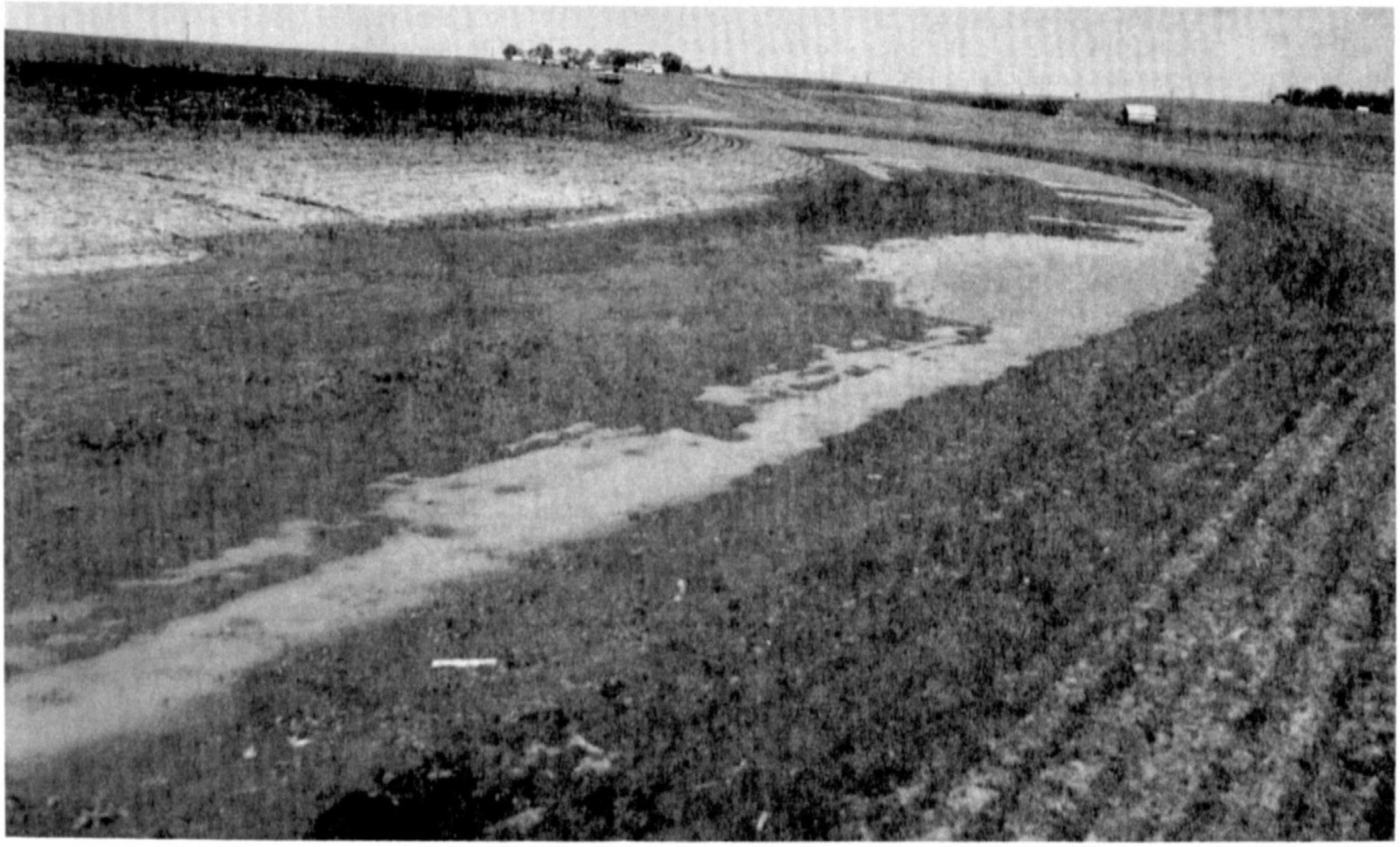

Figure 13.—A flat channel-level terrace intercepts runoff on Hastings silty clay loam, 3 to 6 percent slopes, eroded.

This soil has a low water intake rate. It puddles after hard rains or if worked when it is too wet and becomes hard when dry. A cropping system that includes close grown crops most of the time, such as wheat, alfalfa, or grasses, improves soil tilth and the water intake rate and helps control erosion. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve the low organic matter content, low natural fertility, poor tilth, and low water intake rate. Phosphorus is needed for good alfalfa production.

If irrigated, this soil is suited to grasses and such legumes as alfalfa. If erosion is controlled, this soil is suited to corn, grain sorghum, and soybeans. Sprinkler irrigation is better than other methods of irrigating this soil. Contour bench leveling is suited to some of the less sloping areas. The slope makes it difficult to control erosion caused by rainfall and runoff of irrigation water. The conservation practices used in dryland areas can be used in irrigated areas. Terraces present few problems for center-pivot sprinkler systems and aid in intercepting runoff to prevent erosion along wheel tracks. Terraces should be kept in grass so that the depth of wheel tracks is kept to a minimum. Additional crop residue is available as a result of irrigation. Application of irrigation water should be based on the low water intake rate of this soil.

This soil is suited to use as rangeland. Grasses greatly reduce the hazard of erosion. Overgrazing reduces the protective vegetative cover, deteriorates the native plant community, and increases runoff and soil loss. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper grazing, a planned grazing system of use and rest, and restricted use during wet periods maintain or improve the native grasses and keep the soil in good condition.

If this soil is used for windbreaks, it is suited to trees that can tolerate moderate drought. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Planting tree rows on the contour or planting a cover crop between the rows helps to reduce the hazard of erosion. Seedlings may need supplemental water during dry seasons.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields. This limitation can generally be overcome by increasing the size of the absorption area. For sewage lagoon areas, grading is necessary to modify the slope and to shape the lagoon. Lateral seepage from sewage lagoons is also a limitation unless the lagoon is lined or sealed. The high shrink-swell potential of the subsoil is a limitation for dwelling and building sites. Foundations and footings should be designed to prevent structural damage caused by the shrinking and swelling of this soil. The high shrink-swell potential and low strength are limitations for local roads and streets but can be overcome by strengthening or replacing the base material.

This soil is in capability units IIIe-8, dryland, and IIIe-3, irrigated; the Silty range site; and windbreak suitability group 3.

HdD2—Hastings silty clay loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well drained soil typically is on short sides of upland drainageways and on side slopes of upland breaks to stream terraces or bottom lands. A few areas are on the sides of drainageways crossing terraces. Rills and gullies are common on this soil. Individual areas are irregular in shape and range from 5 to 200 acres.

Typically, the surface layer is brown, firm silty clay loam about 4 inches thick. The subsoil is about 11 inches thick. The upper part is brown, firm silty clay loam; and the lower part is pale brown silty clay loam. The underlying material is very pale brown silt loam to a depth of 60 inches. The lower part is calcareous. In most areas, erosion has removed all of the original, dark, silt loam surface layer and, in places, part of the subsoil. In places, the underlying material is exposed at the surface as a result of erosion. Some profiles have lime at a depth of less than 36 inches, and in some areas, lime is at the surface.

Included with this soil in mapping, and making up 15 percent or less of the map unit, are small areas of Geary, eroded; Uly; and Hobbs soils. Geary soils are on side slopes below the Hastings soils. Hobbs soils are on the bottoms of drainageways. Uly soils are on steeper slopes.

Permeability is moderately slow, and available water capacity is high in this Hastings soil. The water intake rate is low. Runoff is medium to rapid. Reaction in the surface layer ranges from slightly acid to moderately alkaline depending on the extent of erosion. Natural fertility and organic matter content are low as a result of the loss of the surface layer by erosion. Available phosphorus is deficient. Tilth is poor in this eroded soil. The shrink-swell potential is high.

Nearly all areas of this soil are used for dryland farming. A few areas are irrigated. Some areas have been reseeded to native grass and are generally adjacent to steep slopes.

If used for dryland farming, this soil is poorly suited to corn and grain sorghum. It is better suited to legumes and grasses for hay and pasture. Sheet and gully erosion are difficult to control if this soil is cultivated and the surface is not protected. Row crops should be limited in the cropping sequence. Terraces, contour farming, and grassed waterways reduce runoff. Conservation tillage practices that leave crop residue on the soil control water erosion and soil blowing and conserve soil moisture. Crop stubble left standing throughout winter catches drifting snow for additional soil moisture and also controls soil blowing. This soil has a low water intake rate. The soil becomes puddled after hard rains or if worked when it is too wet and becomes hard when dry. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve the low organic matter content, low natural fertility, poor tilth, and low water intake rate. Phosphorous fertilizer is needed for good alfalfa production.

If irrigated, this soil is suited to close grown crops, such as small grain and legumes and grasses for hay and pasture. The gravity irrigation system is unsuited to this soil because of the difficulty in controlling the water. The conservation practices used in dryland areas can be used in irrigated areas. Terraces are beneficial for center-pivot sprinkler systems and help to intercept runoff and prevent erosion, especially along wheel tracks. Terraces should be kept in grass so that the depth of wheel tracks is kept to a minimum. Additional crop residue is available as a result of irrigation. Application of irrigation water should be based on the slow intake rate of this soil.

This soil is suited to use as rangeland. Grasses effectively reduce the hazard of erosion. Overgrazing reduces the protective vegetative cover, deteriorates the native plant community, and increases runoff and soil losses. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper grazing, a planned grazing system of use and rest, and restricted use during wet periods help to maintain or improve the native grasses and keep the soil in good condition. Earth dams can be constructed on drainageways to store runoff water for livestock use.

If this soil is used for windbreaks, it is suited to growing trees that tolerate moderate droughts. If competing vegetation is controlled or removed, the seedlings generally survive. Growth may be slower on this Hastings soil than on less sloping soils. Planting tree rows on the contour, using terraces, and planting a cover crop between the rows help to reduce the erosion hazard. Seedlings may need supplemental water during dry seasons.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields. This limitation can be overcome by increasing the size of the absorption area. The steepness of slope can cause lateral seepage from septic tank absorption fields and sewage lagoons. Septic tank absorption fields can be constructed on the contour after the site is graded. For sewage lagoons, extensive grading is necessary to modify the slope and to shape the lagoon. Sewage lagoons need to be lined or sealed to prevent seepage. Adjacent, less sloping soils are better sites for sewage lagoons and septic tank absorption fields.

The high shrink-swell potential of the subsoil is a limitation for dwelling and building sites. Foundations and footings should be designed to prevent structural damage caused by the shrinking and swelling of this soil. Diversions and special installations are needed to prevent rapid runoff. The high shrink-swell potential and low strength are limitations for roads and streets. These limitations can be overcome by strengthening or replacing the base material.

This soil is in capability units IVe-8, dryland, and IVe-3, irrigated; the Silty range site; and windbreak suitability group 3.

He—Hobbs silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on long and narrow bottom lands along intermittent streams and on long and wide bottom lands along perennial streams. It is occasionally flooded. Individual areas range from 5 to about 3,000 acres.

Typically, the surface layer is grayish brown, very friable silt loam about 7 inches thick. The underlying material to a depth of 60 inches is stratified, grayish brown and brown silt loam in the upper part; stratified, gray and grayish brown silt loam in the middle part; and brown and stratified, brown and pale brown silt loam in the lower part. In some areas the surface layer is silty clay loam or fine sandy loam. The surface layer varies in color and texture depending on the source of recent deposition. Some areas of this soil along major streams are underlain with sand.

Included with this soil in mapping, and making up 15 percent or less of the map unit, are small areas of Hord soils, small areas of frequently flooded soils, small wet areas in which the seasonal high water table is at a depth of 2 feet, and small areas of soils on short, steep slopes. Hord soils are on terraces. The frequently flooded soils are in slightly lower positions on the landscape than the Hobbs soil. The wet areas are mostly in old river channels and oxbows. The short, steep slopes are on the outer boundaries of the mapped areas, separating the bottom land from the terrace or upland.

Permeability and the water intake rate are moderate in this Hobbs soil. The available water capacity is high, and moisture is released readily to plants. Runoff is slow. Tilth is good in this very friable soil. The organic matter content is moderate, and natural fertility is high. The shrink-swell potential is low.

Most areas of this soil along intermittent streams and some areas along perennial streams are farmed. Most of the farmed areas are used for dryland farming, but some areas are irrigated. The rest of this soil is in native grass and trees and is used for grazing and as wildlife habitat.

If used for dryland farming, this soil is suited to grain sorghum, small grain, corn, and legumes and grasses for hay and pasture. Occasional flooding, although brief in duration, can delay planting and tilling or damage crops by scouring and sedimentation. Alfalfa and small grain can be easily damaged by flooding. In dry years, however, some areas in row crops benefit from the extra moisture. If flooding occurs in spring, crops with a shorter growing season can be replanted later. Floodwater can be retained by levees, intercepted by diversions, or drained by ditches in most areas of this soil.

Returning crop residue and green manure crops to the soil and applying barnyard manure are needed to improve organic matter content, fertility, tilth, and the water intake rate. Immediate incorporation of barnyard manure into the soil is necessary so that flooding does not carry it downstream.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture. The center-pivot sprinkler system is often limited because of the adjacent intermittent or perennial streams and steep upland soils. Irrigation water can be conserved if its application is based on the moderate water intake rate of this soil. In the gravity irrigation system, furrows can be occasionally washed out by flooding. Using levees and diversions can lessen this occurrence. The tailwater recovery system is needed to conserve runoff of irrigation water.

This soil is suited to rangeland. Occasional flooding can damage the grasses and introduce weeds which deteriorate the native plant community. Weeds and grazing need to be controlled so that desirable grasses are able to reseed. Levees and diversions may be needed to protect the grasses and to keep them in good condition. Delayed grazing after floods is necessary to avoid compaction. Grasses that can tolerate shade should be grown in areas that have many trees.

This soil is suited to growing trees in windbreaks. Flooding can occasionally damage new plantings. Once the plantings are established, however, additional moisture is beneficial. Competitive grasses, weeds, and shrubs should be controlled. Young trees should be protected from livestock grazing.

This soil is not suited to use as building sites, septic tank absorption fields, or sewage lagoons because of the hazard of flooding. Suitable sites can usually be located on the adjacent, higher terrace soils that are not subject to flooding. Roads may be closed and damaged during floods and may need extensive rebuilding afterwards. They need to be constructed on raised, well compacted fill material with adequate culverts and bridges.

This soil is in capability units IIw-3, dryland, and IIw-6, irrigated; the Silty Overflow range site; and windbreak suitability group 1.

Hf—Hobbs silt loam, channeled. This deep, nearly level and very gently sloping, well drained soil is on frequently flooded bottom lands along perennial and intermittent streams. Many areas are broken by meandering channels and steep streambanks. Individual areas are long and narrow and range from 70 to 2,000 acres.

Typically, the surface layer is stratified, grayish brown and pale brown, very friable silt loam about 9 inches thick. The underlying material to a depth of 60 inches is stratified, grayish brown and pale brown silt loam in the upper part; grayish brown and dark gray silt loam in the middle part; and pale brown loam in the lower part. In some areas the surface layer is silty clay loam or fine sandy loam. It varies in color and texure depending on the source of recent deposition. Some areas of this soil are underlain with gravelly sand. Mottles are present in the profile in some areas.

Included with this soil in mapping, and making up 15 percent or less of the map unit, are small areas of occasionally flooded soils, small wet areas in which the seasonal high water table is at a depth of 2 feet or less, and areas that have short, steep slopes. The occasionally flooded areas are in slightly higher positions on the landscape than this Hobbs soil. The wet areas are mostly in old river channels and oxbows. The short, steep slopes are on the outer boundary of the mapped area and separate the bottom land from the terraces or upland.

Permeability is moderate, and available water capacity is high in this Hobbs soil. Moisture is released readily to plants, and runoff is slow. Tilth is good in this very friable soil. The organic matter content is moderate, and natural fertility is high. The shrink-swell potential is low.

Nearly all areas of this soil are in native grass and trees. These areas are used for grazing and as wildlife habitat.

This soil is unsuited to cultivated crops because of the frequent hazard of flooding and steep slopes along meandering channels.

This soil is suited to rangeland. Frequent flooding, although brief in duration, causes sedimentation and channeling and brings in debris and weed seeds. Weeds and grazing should be controlled so that desirable grasses are able to reseed. Grazing should be delayed after floods to avoid compaction.

This soil is unsuited to growing trees in most windbreaks. It is somewhat suited to windbreaks for livestock protection and wildlife plantings. Only trees and shrubs that can tolerate the wetness caused by flooding are suited to this soil. Many trees become established naturally (fig. 14). Once they are established, additional moisture is beneficial.

This soil is unsuited to use as building sites, septic tank absorption fields, or sewage lagoons because of the hazard of flooding. Suitable sites can be located on adjacent, higher-lying soils that are not subject to flooding. Roads and streets may be closed or damaged during floods. They need to be constructed on raised, well compacted fill material with adequate culverts and bridges.

This soil is in capability unit VIw-7, dryland; the Silty Overflow range site; and windbreak suitability group 10.

HgC—Holder silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is mostly on narrow, convex divides between steep upland drainageways. Some areas are on upper side slopes of upland breaks to stream terraces, on convex ridges bordered by less sloping uplands adjacent to stream terraces or bottom lands. A few areas are on the sides of drainageways crossing terraces. Individual areas are irregular in shape and range from 5 to 180 acres.

Typically, the surface layer is grayish brown, very friable silt loam about 9 inches thick. The subsoil is about 23 inches thick. It is brown, friable silt loam in the upper part; pale brown, firm silty clay loam in the middle part; and pale brown, friable silt loam in the lower part. The underlying material is very pale brown, calcareous silt loam to a depth of 60 inches. In some cultivated areas, the surface layer is less than 7 inches thick and is sometimes mixed with the subsoil by plowing. The subsoil is more than 35 percent clay in some areas.

Included with this soil in mapping, and making up 10 percent or less of the map unit, are small areas of Geary and Hord soils. Geary soils are in lower positions on narrow divides and side slopes than this Holder soil. Hord soils are on less sloping foot slopes.

Permeability is moderate, and available water capacity is high in this Holder soil. The water intake rate is moderately low. Runoff is medium. The very friable surface layer is easily tilled. The subsoil has moderate shrink-swell potential. The organic matter content is moderate, and natural fertility is high.

Most areas of this soil are in native grass and are used for grazing. The rest is mainly used for dryland farming, but some areas are irrigated.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay and pasture. It is somewhat suited to corn. Water erosion caused by runoff is the main hazard on this soil. Runoff can be controlled by using terraces, contour farming, and grassed waterways. Conservation tillage practices that leave crop residue on the soil help to reduce water erosion and soil blowing and to conserve soil moisture. Crop stubble left standing throughout winter catches drifting snow for additional soil moisture and also controls soil blowing.

A cropping system that includes close grown crops, such as wheat, alfalfa, or grasses, provides additional erosion control and improves soil tilth and water intake. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve organic matter content, fertility, tilth, and the water intake rate.

If irrigated, this soil is suited to grasses and legumes such as alfalfa. If erosion is controlled, this soil is suited to corn, grain sorghum, and soybeans. The sprinkler system is the best method of irrigating this soil. However,

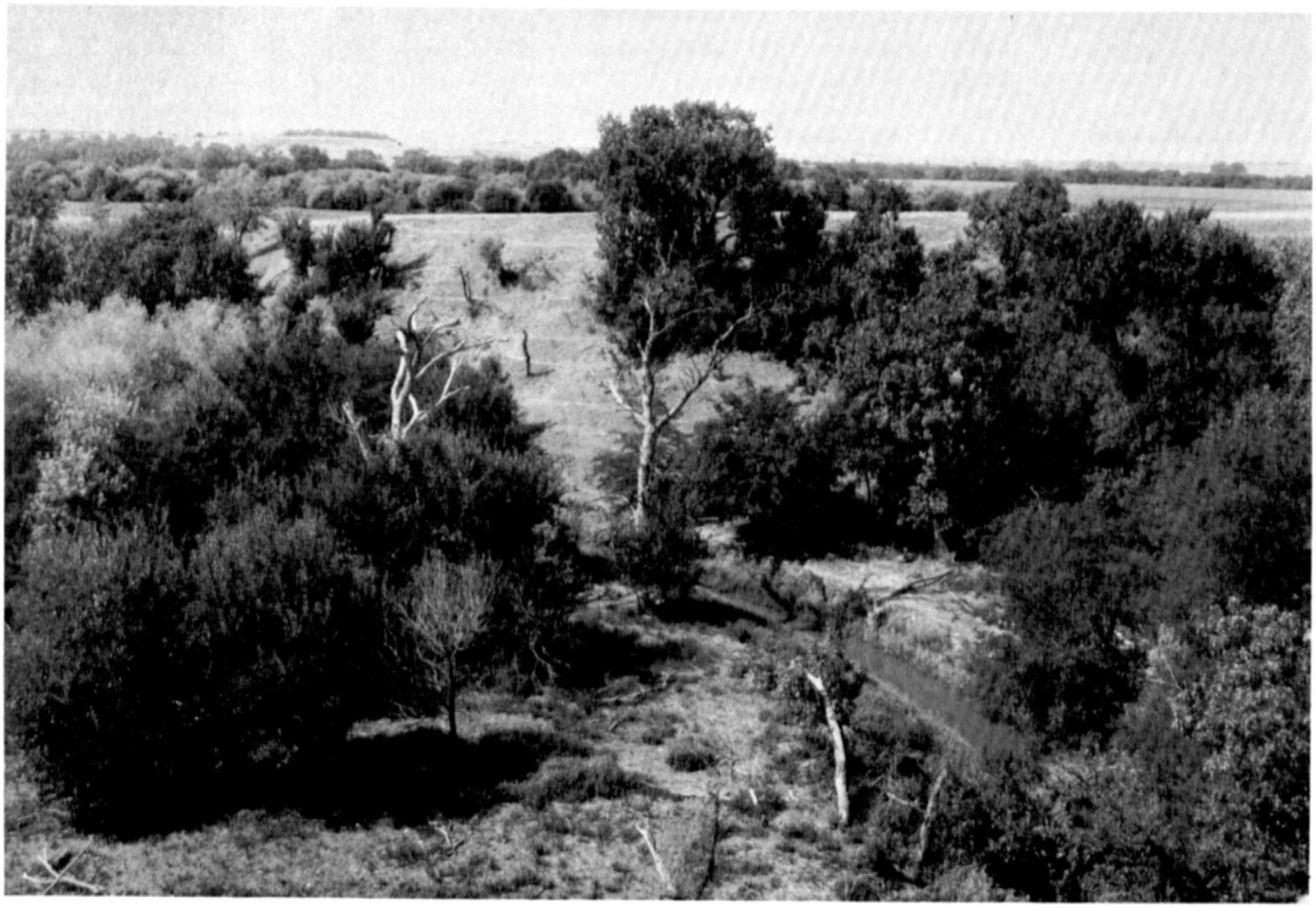

Figure 14.—Good natural habitat for wildlife along the West Fork of the Big Blue River on Hobbs silt loam, channeled.

adjacent, steep drainageways often limit the use of this system. Contour bench leveling is beneficial on some of the less sloping areas. The slope makes it difficult to control erosion caused by rainfall and runoff of additional irrigation water. The application of irrigation water should be based on the water intake rate of this soil. Additional crop residue is available if the soil is irrigated. Returning crop residue to the soil helps to improve the water intake rate, to conserve moisture, and to improve soil fertility and tilth.

This soil is suited to use as rangeland. Native grasses effectively control erosion. Overgrazing reduces the protective vegetative cover, deteriorates the native plant community, and increases runoff and soil loss. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and keep the soil in good condition.

This soil is suited to growing moderately drought resistant trees in windbreaks. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Planting tree rows on the contour and leaving strips of sod, or planting a cover crop between the rows helps to reduce the hazard of erosion. Seedlings may need supplemental water during dry seasons.

This soil is well suited to septic tank absorption fields. Seepage is a limitation for sewage lagoons but can be overcome by lining or sealing the lagoon. Grading is necessary to modify the slope and to shape the lagoon.

The moderate shrink-swell potential of the subsoil is a limitation for building sites. Foundations and footings for dwellings and small buildings should be properly designed to prevent structural damage caused by the shrinking and swelling of the soil. Low strength is a limitation for local roads and streets. This limitation can be overcome by strengthening or replacing the base material. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is in capability units IIIe-1, dryland, and IIIe-4 irrigated; the Silty range site; and windbreak suitability group 3.

HgD—Holder silt loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is mostly on narrow, convex divides between steep upland drainageways. Some areas are on sides of upland drainageways. Individual areas are irregular in shape and range from 5 to 40 acres.

Typically, the surface layer is dark grayish brown, very friable silt loam about 7 inches thick. The subsoil is about 24 inches thick. It is grayish brown, friable silt loam in the upper part; brown, firm silty clay loam in the middle part; and pale brown, friable silt loam in the lower part. The underlying material is very pale brown silt loam to a depth of about 60 inches. In some cultivated areas, the surface layer is less than 7 inches thick and, in places, is mixed with material from the subsoil by plowing. It is neutral in reaction in some profiles. The subsoil is more than 35 percent clay in some areas. Some areas have lime at a depth of less than 36 inches.

Included with this soil in mapping, and making up 15 percent or less of the map unit are small areas of Geary, Uly, and Hobbs soils. Geary soils are in lower positions on narrow divides and side slopes than this Holder soil. Uly soils are on steeper slopes. Hobbs soils are on the bottoms of drainageways.

Permeability is moderate, and available water capacity is high in this Holder soil. The water intake rate is moderately low. Runoff is medium to rapid. The very friable surface layer is easily tilled. The subsoil has moderate shrink-swell potential. The organic matter content is moderate, and natural fertility is high.

Nearly all areas of this soil are in native grass and used for grazing or hay. The rest is used for dryland farming, and a few areas are irrigated.

If used for dryland farming, this soil is poorly suited to corn and grain sorghum. Close grown crops, such as small grain and legumes and grasses for hay and pasture, are better suited to this soil than row crops. Row crops should be limited in the cropping sequence.

Sheet and gully erosion are difficult to control if this soil is cultivated. Runoff can be controlled by using terraces, contour farming, and grassed waterways. Conservation tillage practices that leave crop residue on the soil help to reduce water erosion and soil blowing and to conserve moisture. Crop stubble left standing throughout winter catches drifting snow for additional soil moisture and also controls soil blowing. Returning crop residue and green manure crops to the soil and applying barnyard manure help to increase organic matter content, maintain good tilth, and improve the water intake rate.

If irrigated, this soil is limited to the sprinkler irrigation system and to close grown crops, such as small grain and legumes and grasses, because of the difficulty in controlling the flow of water. Application of irrigation water should be based on the water intake rate of this soil. Additional crop residue is available if the soil is irrigated.

This soil is suited to use as rangeland. Grasses effectively control erosion. Overgrazing reduces the protective vegetative cover, deteriorates the native plant community, and increases runoff and soil loss. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and keep the soil in good condition.

This soil is suited to growing moderately drought resistant trees in windbreaks. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Growth may be slower on this Holder soil than on less sloping soils. Planting tree rows on the contour, using terraces, and leaving strips of sod or planting a cover crop between the rows help to reduce the hazard of erosion. Seedlings may need supplemental water during dry seasons.

The steepness of slope is a limitation for septic tank absorption fields and sewage lagoons and may cause lateral seepage downslope. Septic tank absorption fields can be constructed on the contour after the site is graded. For sewage lagoons, extensive grading is necessary to modify the slope and to shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. Adjacent, less sloping soils are better sites for sewage lagoons and septic tank absorption fields.

The steepness of slope and the moderate shrink-swell potential of the subsoil are limitations for building sites. Foundations and footings for dwellings and small buildings should be designed to prevent the structural damage caused by the shrinking and swelling of the soil. Dwellings and small commercial buildings need to be properly designed to accommodate the slope, or the soil can be graded. Diversions and special installations are needed to protect building sites from runoff from adjacent areas. Low strength is a limitation for local roads and streets. This limitation can be overcome by strengthening or replacing the base material. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is in capability units IVe-1, dryland, and IVe-4, irrigated; the Silty range site; and windbreak suitability group 3.

HhC2—Holder silty clay loam, 3 to 6 percent slopes, eroded. This deep, gently sloping, well drained soil is mostly on short side slopes of upland drainageways and on upper side slopes of upland breaks to stream terraces. Some areas are on narrow convex divides between steep upland drainageways and on narrow convex ridges bordered by less sloping uplands. A few areas are on terrace breaks or on the sides of drainageways that cross terraces. Rills and small gullies are common on this eroded soil. Individual areas are irregular in shape and range from 5 to 80 acres.

Typically, the surface layer is brown, friable silty clay loam about 5 inches thick. The subsoil is about 17 inches thick. The upper part is pale brown, firm silty clay loam; and the lower part is pale brown, friable silt loam. The underlying material is pale brown and very pale brown, calcareous silt loam to a depth of about 60 inches. In most areas, erosion has removed some to all of the original, dark, silt loam surface layer and, in places, part of the subsoil. The subsoil is more than 35 percent clay in some areas. In a few places the underlying material is exposed at the surface as a result of erosion or land leveling. Most areas have lime at a depth of less than 36 inches, and in some areas, lime is at the surface.

Included with this soil in mapping, and making up 10 percent or less of the map unit, are small areas of Geary, eroded; Hobbs; and Hord soils. The Geary soils are on lower side slopes than this Holder soil. Hobbs soils are on the bottoms of drainageways. Hord soils are on less sloping foot slopes.

Permeability is moderate, and available water capacity is high in this Holder soil. The water intake rate is low. Runoff is medium. Reaction in the surface layer ranges from slightly acid to moderately alkaline, depending on the extent of erosion. Natural fertility is moderately low, and organic matter content is low as a result of the loss of the original, dark surface layer by erosion. Available phosphorus and zinc are especially deficient on deep cuts made during land leveling. Low organic matter content and the eroded surface layer make this soil difficult to till. The shrink-swell potential is moderate.

Nearly all areas of this soil are farmed. Most of the areas are used for dryland farming, but some are irrigated. A few areas, which are generally adjacent to or between steep drainageways, have been reseeded to native grass.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay and pasture. It is somewhat suited to corn.

Water erosion caused by runoff is the main hazard on this soil. Terraces, contour farming, and grassed waterways help to reduce runoff. Conservation tillage practices that leave crop residue on the soil help to control water erosion and soil blowing and conserve soil moisture. Crop stubble left standing throughout winter catches drifting snow for additional soil moisture and also controls soil blowing. This soil has a low water intake rate, becomes puddled after hard rains or if it is worked when too wet, and becomes hard when dry. A cropping system that includes close grown crops most of the time, such as wheat, alfalfa, or grasses, improves soil tilth and the water intake rate and also helps to control erosion. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve the low organic matter content, low fertility, poor tilth, and the low water intake rate. Phosphorus is needed for good alfalfa production.

If irrigated, this soil is suited to grasses and legumes, such as alfalfa, and, if erosion is controlled, to corn, grain sorghum, and soybeans. The sprinkler irrigation system is the best method of irrigating this soil. Contour bench leveling is suited to some of the less sloping areas. The slope causes problems because of the difficulty in controlling erosion caused by rainfall and runoff of additional irrigation water. Terraces present few problems for center-pivot sprinkler systems and aid in intercepting runoff to prevent erosion, especially along wheel tracks. Terraces should be kept in grass so that the depth of wheel tracks is kept to a minimum. Additional crop residue is available as a result of irrigation. Application of irrigation water should be based on the low water intake rate of this soil.

This soil is suited to use as rangeland. Native grasses reduce the hazard of erosion. Overgrazing reduces the protective vegetative cover, deteriorates the native plant community, and increases runoff. Grazing when the soil is too wet causes surface compaction. Proper grazing, a planned grazing system of use and rest, and restricted use during wet periods help to maintain and improve the native grasses and keep the soil in good condition.

Where this soil is used for windbreaks, it is suited to growing trees that can tolerate moderate droughts. If competing vegetation is controlled or removed through good site preparation and timely cultivation, the seedlings generally survive. Planting tree rows on the contour or planting a cover crop between the rows reduces the hazard of erosion. Seedlings may need supplemental water during dry seasons.

This soil is well suited to septic tank absorption fields. Seepage is a limitation for sewage lagoons but can be overcome by lining or sealing the lagoon. Grading is necessary to modify the slope and to shape the lagoon.

The moderate shrink-swell potential of the subsoil is a limitation for building sites. Foundations and footings for dwellings and small buildings should be properly designed to prevent structural damage caused by the shrinking and swelling of the soil. Low strength is a limitation for local roads and streets. This limitation can be overcome by strengthening or replacing the base material. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is in capability units IIIe-8, dryland, and IIIe-3, irrigated; the Silty range site; and windbreak suitability group 3.

HhD2—Holder silty clay loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well drained soil is typically on short sides of upland drainageways and on upper side slopes of upland breaks to stream terraces or bottom lands. Rills and gullies are common on this eroded soil. Individual areas are irregular in shape and range from 5 to 140 acres.

Typically, the surface layer is brown, friable silty clay loam about 5 inches thick. The subsoil is about 15 inches thick. The upper part is pale brown, firm silty clay loam; and the lower part is very pale brown, friable silt loam. The underlying material is very pale brown, calcareous silt loam to a depth of 60 inches. In most areas, erosion has removed all of the original, dark silt loam surface layer and, in places, part of the subsoil. In many places the underlying material is exposed at the surface as a result of erosion. Most profiles have lime at or near the surface.

Included with this soil in mapping, and making up 15 percent or less of the map unit, are small areas of Uly and Hobbs soils. Hobbs soils are on the bottoms of drainageways. Uly soils are on steeper slopes than this Holder soil.

Permeability is moderate, and available water capacity is high in this Holder soil. The water intake rate is low. Runoff is medium to rapid. Reaction in the surface layer ranges from slightly acid to moderately alkaline depending on the extent of erosion. Natural fertility is moderately low, and organic matter content is low as a result of the loss of the surface layer by erosion. Available phosphorus is deficient. The low organic matter content of the eroded surface layer makes this soil difficult to till. This soil has moderate shrink-swell potential.

Nearly all areas of this soil are used for dryland farming. Only a few areas are irrigated. Some areas have been reseeded to native grass and are used for grazing or hay.

If used for dryland farming, this soil is poorly suited to corn and grain sorghum. Close grown crops, such as small grain and legumes and grasses for hay and pasture, are better suited than row crops. Sheet and gully erosion are difficult to control if this soil is cultivated and the surface is not protected. Terraces, contour farming, and grassed waterways help to reduce runoff. Conservation tillage practices that leave crop residue on the soil also control water erosion and soil blowing and conserve soil moisture. Crop stubble left standing throughout winter catches drifting snow for additional soil moisture and also controls soil blowing. This soil has a low water intake rate, becomes puddled after hard rains or if it is worked when too wet, and becomes hard when dry. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve organic matter content, fertility, tilth, and the water intake rate. Phosphorous fertilizer is needed for good alfalfa production.

If sprinkler irrigated, this soil is suited to close grown crops, such as small grain and legumes and grasses for hay and pasture. The gravity irrigation system is unsuited to this soil because of the difficulty in controlling the flow of water. Terraces present few problems for center-pivot sprinkler systems and aid in intercepting runoff and in preventing erosion, especially along wheel tracks. Terraces should be kept in grass so that the depth of wheel tracks is kept to a minimum. Additional crop residue is available as a result of irrigation. Application of irrigation water should be based on the low intake rate of this soil.

This soil is suited to use as rangeland. Native grasses minimize the hazard of erosion. Overgrazing reduces the protective vegetative cover, deteriorates the native plant community, and increases runoff and soil loss. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper grazing, a planned grazing system of use and rest, and restricted use during wet periods helps to maintain or improve the native grasses and keep the soil in good condition. Earth dams can be constructed on drainageways to intercept runoff for watering of livestock.

If this soil is used for windbreaks, it is suited to growing trees that tolerate moderate droughts. If competing vegetation is controlled or removed, seedlings generally survive. Growth may be slower on this Holder soil than on less sloping soils. Planting tree rows on the contour, using terraces, and planting a cover crop between the rows help to reduce the hazard of erosion. Seedlings may need supplemental water during dry seasons.

This soil is well suited to septic tank absorption fields. Seepage is a limitation for sewage lagoons but can be overcome by lining or sealing the lagoon. Grading is necessary to modify the slope and to shape the lagoon.

The moderate shrink-swell potential of the subsoil is a limitation for building sites. Foundations and footings for dwellings and small buildings should be properly designed to prevent structural damage caused by the shrinking and swelling of the soil. Low strength is a limitation for local roads and streets. This limitation can be overcome by strengthening or replacing the base material. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is in capability units IVe-8, dryland, and IVe-3, irrigated; the Silty range site; and windbreak suitability group 3.

Hr—Hord silt loam, 0 to 1 percent slopes. This nearly level, well drained soil is on high and low terraces along perennial and intermittent streams. The soil is rarely flooded. Individual areas are mostly long, broad, and oblong and range from 5 to about 400 acres.

Typically, the surface layer is gray and dark gray, very friable silt loam about 15 inches thick. The subsoil is about 39 inches thick. The upper part is dark grayish brown, friable silt loam; the middle part is grayish brown, friable silt loam; and the lower part is dark grayish brown, buried silt loam. The underlying material is brown silt loam to a depth of 60 inches. In a few small areas, the surface layer is more than 24 inches thick, is dark to a depth of less than 20 inches, or is fine sandy loam or silty clay loam. In some small areas, the subsoil is more than 35 percent clay. Also, some small areas are underlain with sandy material below a depth of 40 inches.

Included with this soil in mapping, and making up less than 10 percent of the map unit, are soils on short, steep slopes on sides of drainageways that cross the terraces. Also included are soils on short, steep slopes that are between low and high terraces. A few small areas are adjacent to basins on uplands.

This Hord soil has moderate permeability and a moderate water intake rate. The available water capacity is high, and moisture is released readily to plants. Runoff is slow. The organic matter content is moderate, and natural fertility is high. Tilth is good. The shrink-swell potential is low.

Most areas of this soil are farmed, and the rest is mainly in native grass. The farmed areas are mostly irrigated, but some are not. The native grass areas are generally adjacent to bottom lands.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay and pasture. It is somewhat suited to corn. Where this soil is used for cultivated crops, there is a problem of conserving soil moisture and preventing soil blowing. Conservation tillage practices that leave crop residue on the soil help to prevent this problem. Crop stubble left standing throughout winter catches drifting snow for additional moisture and prevents soil blowing. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve organic matter content, tilth, the water intake rate, and fertility.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture. The area available for a center-pivot irrigation system is often limited by adjacent streams and steep upland soils. Applying irrigation water at a rate based on the moderate water intake rate of this soil helps to reduce runoff. If gravity irrigation is used, the tailwater recovery system is needed to conserve runoff of irrigation water.

This soil is suited to rangeland. Native grass vegetation effectively controls soil blowing. Overgrazing reduces the protective vegetative cover and causes deterioration of the native plant community. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and keep the soil in good condition.

This soil is suited to growing trees in windbreaks. Seedlings generally survive and grow if competing vegetation is controlled or removed. This can be accomplished through good site preparation and timely cultivation. Seedlings may need watering during dry periods.

The hazard of rare flooding should be considered if this soil is to be used for building sites and sanitary facilities. Dwellings and buildings can be constructed on elevated, well compacted fill material to protect against flooding. Dikes can be used to protect septic tank absorption fields and sewage lagoons. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. Constructing roads on suitable compacted fill material and providing adequate side ditches and culverts help to protect roads from flood damage.

This soil is in capability units I-1, dryland, and I-6, irrigated; the Silty Lowland range site; and windbreak suitability group 1.

HrB—Hord silt loam, 1 to 3 percent slopes. This very gently sloping, well drained soil is on colluvial foot slopes between the upland breaks and the nearly level stream terraces. A few areas are on the sides of shallow drains that cross the stream terraces and on colluvial foot slopes along upland drainageways. The soil is rarely flooded. Individual areas are narrow and irregular in shape and range from 5 to about 40 acres.

The surface layer is grayish brown and dark grayish brown, very friable silt loam about 15 inches thick. The subsoil is about 35 inches thick. The upper part is brown, friable silty clay loam, and the lower part is pale brown, friable silt loam. The underlying material is very pale brown silt loam to a depth of 60 inches. In a few small areas, less than 20 inches of the surface layer is dark colored. In some areas the surface layer is more than 24 inches thick. In some areas the surface layer is fine sandy loam or loam, and the subsoil is more than 35 percent clay.

Included with this soil in mapping, and making up less than 15 percent of the map unit, are small areas of Hastings and Holder soils, soils on sides of drainageways, and a few small areas of sand and gravel. The Hastings soils are on upland slopes. The Holder soils are on uplands and are steeper than the Hord soil. The sand and gravel have been washed in from the higher-lying areas of Meadin soils.

Permeability and the water intake rate are moderate in this Hord soil. Moisture is released readily to plants, and available water capacity is high. The organic matter content is moderate, and natural fertility is high. Tilth is good. The shrink-swell potential is low.

Most areas of this soil are farmed. The rest is mainly in native grass. About half of the farmed areas are irrigated. The other half is used for dryland farming. The native grass areas are generally adjacent to more sloping uplands or bottom lands.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes for hay and pasture. It is somewhat suited to corn. If this soil is used for cultivated crops, there is a hazard of water erosion caused by runoff. Runoff can be controlled by using terraces, contour farming, and grassed waterways. Following heavy rains, water from adjacent, higher slopes can cause rills to form. Diversions may be needed. Conservation tillage practices that leave crop residue on the soil and crop stubble left standing throughout winter help to prevent loss of soil and moisture. Returning crop residue and green manure crops to the soil and applying barnyard manure help to improve organic matter content, tilth, the water intake rate, and fertility.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes for hay and pasture. If gravity irrigation is used, contour bench leveling can be used to control water erosion and a tailwater recovery system is needed to conserve runoff of irrigation water. Irrigation water can be conserved if the application rate is based on the moderate water intake rate. The center-pivot irrigation system generally has limitations because of adjacent streams and steep uplands.

This soil is suited to rangeland. Grasses effectively control erosion. Overgrazing reduces the protective vegetative cover and causes deterioration of the native plant community. Proper grazing and a planned grazing system of use and rest help to maintain or improve the native grasses and keep the soil in good condition.

This soil is suited to growing trees in windbreaks. Seedlings generally survive and grow if competing vegetation is controlled or removed through good site preparation and timely cultivation. Where feasible, trees can be planted on the contour to prevent water erosion. Seedlings may also need watering during dry periods.

The hazard of rare flooding should be considered if this soil is to be used for building sites and sanitary facilities. Dwellings and buildings can be constructed on elevated, well compacted fill material to protect against flooding. Dikes can be used to protect septic tank absorption fields and sewage lagoons. Low strength is a limitation for local roads and streets, but this limitation can be overcome by strengthening or replacing the base material. Constructing roads on suitable compacted fill material and providing adequate side ditches and culverts help to protect roads from flood damage.

This soil is in capability units IIe-1, dryland, and IIe-6, irrigated; the Silty Lowland range site; and windbreak suitability group 1.

Ma—Massie silty clay loam, 0 to 1 percent slopes. This deep, nearly level, ponded and very poorly drained, claypan soil is in the lowest, wettest parts of depressions or basins of uplands. Individual areas are somewhat oblong or oval and range from 5 to 280 acres.

Typically, there is a layer of partially decayed leaves and stems on the surface. The surface layer is very dark gray and dark gray, very friable silty clay loam about 7 inches thick. The subsurface layer is light gray, very friable silt loam about 2 inches thick. The subsoil to a depth of about 60 inches is dark gray, firm silty clay loam in the upper part; and dark gray and gray, very firm silty clay in the lower part. In some areas there is no subsurface layer and the upper part of the subsoil is silty clay. A buried surface layer is common in some areas.

Included with this soil in mapping, and making up 10 percent or less of the map unit, are small areas of Fillmore and Scott soils and open water. Fillmore and Scott soils are on slightly higher elevations than this Massie soil. Open-water areas are devoid of most vegetation.

Permeability is very slow in the claypan subsoil of this Massie soil. The available water capacity is high, but moisture is released slowly to plants. The soil is ponded for very long periods during March through August. In wet years, this soil is covered with 1/2 foot to 2 feet of water most of the time. The perched, seasonal high water table in dry years is at a depth of about 1 foot. The shrink-swell potential is moderate in the surface and subsurface layers and high in the subsoil. The organic matter content is high, and natural fertility is medium.

This soil is in wetland vegetation and is used mainly by wildlife. It is unsuited to dryland farming and irrigation and unsuited to rangeland and windbreaks. It is ponded with water for very long periods.

This soil is suited to wetland wildlife habitat (fig. 15). Potential is poor for grain and seed, grasses and legumes, and wild herbaceous plants. However, higher, adjacent areas can provide food, shelter, and nesting areas for wildlife. Potential for wetland plants is good. Vegetation includes sedges, rushes, cattails, perennial smartweed, arrowhead, pondweed, and reed canarygrass. Waterfowl, such as geese and ducks, are the main wildlife in this habitat. Openland wildlife, such as pheasants, occasionally use wetland habitat for shelter in dry seasons and in wet seasons when the ponded water is frozen in winter. Hunting is the main recreation use of this map unit. Although potential for shallow water areas is good, dry summers and dry falls contribute to dry basins which waterfowl bypass.

This soil is too wet for sanitary facilities and building sites because water is ponded for long periods of time. Sites can be located on higher, adjacent soils that are not subject to ponding. Ponded water, low strength, and the high frost action potential are limitations for roads and streets. These limitations can be overcome by strengthening or replacing the base material and by building roads on raised, well compacted fill material.

This soil is in capability unit VIIIw-7 and windbreak suitability group 10. It is not assigned to a range site.

MdF—Meadin sandy loam, 3 to 30 percent slopes. This soil is shallow over sandy and gravelly material. It is gently sloping to steep and excessively drained. It is mostly on sides of drainageways and low ridges of gravelly uplands and is on lower side slopes of upland breaks to stream terraces or bottom lands. A few areas are on gently sloping foot slopes between the upland breaks and stream terraces. Individual areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is grayish brown, very friable sandy loam about 7 inches thick. The transitional layer is about 4 inches thick. It is brown, very friable coarse sand. The underlying material is very pale brown,

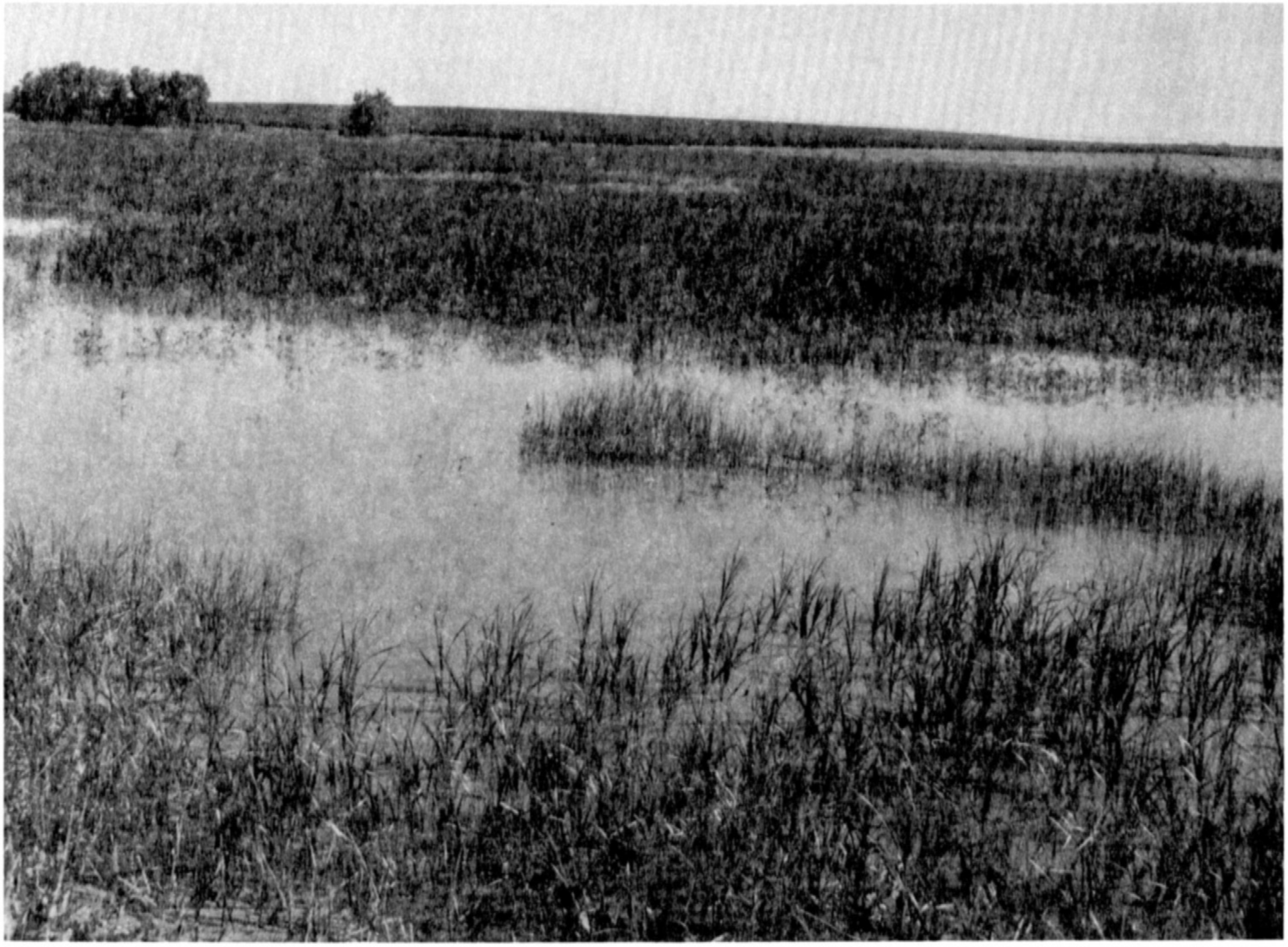

Figure 15.—This upland depression of Massie silty clay loam, 0 to 1 percent slopes, provides excellent habitat for wetland wildlife.

gravelly coarse sand and very gravelly coarse sand to a depth of about 60 inches. The depth to coarse sand and gravel is more than 20 inches in some areas. The coarse sand and gravel is exposed at the surface in eroded areas that have been overgrazed or cultivated and in areas where the slopes are steep.

Included with this soil in mapping, and making up 20 percent or less of the map unit, are small areas of Cass, Geary, and Hobbs soils. Cass and Hobbs soils are on the bottoms of drainageways. Geary soils are in higher positions on the landscape than this Meadin soil.

Permeability is rapid in this Meadin soil. The available water capacity is low, but moisture is released readily to plants. Runoff is medium to rapid, depending on the slopes. The shrink-swell potential is low. The depth of the root zone is 20 inches or less. The organic matter content is moderately low, and natural fertility is low.

Nearly all areas of this soil are in native grasses or have been reseeded to native grass and are used for grazing. A few areas are used for dryland farming.

This soil is generally unsuited to dryland farming because it has a shallow root zone, slopes that are mostly too steep, and a severe hazard of erosion. The few cultivated areas should be reseeded to native grass. Tame grasses for pasture are somewhat unsuited because they usually do not provide enough vegetative cover to prevent erosion.

Irrigation is unsuited to this soil because of the low fertility, low available water capacity, and steep slopes.

This excessively drained soil is suited to rangeland. Overgrazing deteriorates the native plant community and reduces the protective vegetative cover, thereby causing erosion. Leaving about half of the grass ungrazed helps to maintain plant cover, slows runoff, protects the soil, and keeps the quantity and quality of grasses high. The correct placement of fences, livestock watering developments, and salting facilities in pasture can insure the proper distribution of livestock. Reseeding with native grasses that are adapted to sandy soils may be necessary if the plant community has deteriorated.

This soil is unsuited to growing trees in windbreaks because it is too shallow, has low moisture supply, and is too steep for tree planting machinery in most areas. Some areas can be hand planted with trees or shrubs that have a higher drought tolerance for recreation or wildlife purposes. Special care and watering are necessary.

This soil is generally unsuited to most uses because of slope. Suitable alternate sites should be considered. Because of the rapid permeability of the underlying material, septic tank absorption fields can not adequately filter effluent from a waste disposal system. Seepage from septic tank absorption fields and sewage lagoons could contaminate the underground water supply. Extensive cuts and fills are generally needed to provide a suitable grade for roads.

This soil is in capability unit VIs-4, dryland; the Shallow To Gravel range site; and windbreak suitability group 10.

Pt—Pits, Gravel. This map unit consists of excavations from which sand and gravel have been removed. The overburden is usually stockpiled. These areas are mainly along the breaks to and on the bottom lands along the Little Blue River, except for one area on Big Sandy Creek. In places, on breaks, are areas that are shallow to gravelly and sandy glacial outwash. In places, on bottom lands, are areas that are deep to sandy and gravelly alluvium. Individual areas range from 5 to 80 acres.

The overburden and the sand separations from these excavations are usually stockpiled adjacent to the pits and contribute to the steepness of the landscape associated with this map unit. Some of these pits are inactive. Soil blowing and water erosion are the main hazards on recent exposures. Existing overburden can be smoothed and seeded to native grasses, such as big bluestem, little bluestem, indiangrass, switchgrass, and sideoats grama. Sandy material is suited to different native grasses, such as sand reedgrass, sand lovegrass, and sand bluestem. If grass cover is established, these sandy areas are suited to rangeland and wildlife habitat. Water areas are common in open pits. Cottonwood and willow trees are common along the water edges and invade most of the areas on the bottom land pits.

This map unit is in capability unit VIII-5 and windbreak suitability group 10. It is not assigned to a range site.

Sc—Scott silt loam, 0 to 1 percent slopes. This deep, nearly level, very poorly drained, claypan soil is in the lower parts of depressions or basins of uplands. Some areas form a ring around lower, wetter soils. Individual areas are somewhat oval or circular and range from 5 to 100 acres.

Typically, the surface layer is gray, very friable silt loam about 5 inches thick. The subsurface layer is light gray, very friable silt loam about 2 inches thick. The subsoil is about 48 inches thick. It is gray, very firm silty clay loam in the upper part and grayish brown, firm silty clay in the lower part. The underlying material is light brownish gray silty clay loam to a depth of 60 inches. In some areas, soil blowing has mixed the surface with material from the light gray subsurface layer. Plowing has also mixed the surface with material from the subsoil in some cultivated areas.

Included with this soil in mapping, and making up 10 percent or less of the map unit, are small areas of Fillmore and Massie soils and small drained areas. Fillmore soils are better drained than this Scott soil and are in shallower depressions on the landscape. Massie soils are more poorly drained than this Scott soil and are in the lowest, wettest parts of depressions. The drained areas have been filled by land leveling, or ditches to adequate outlets have been installed.

Permeability is very slow in the claypan subsoil of this Scott soil. The available water capacity is high, but moisture is released slowly to plants. Runoff is ponded for long and very long periods during March through August. In wet years this soil is covered with water part of the time. In dry periods the perched, seasonal high water table is at a depth of about 1 foot. The shrink-swell potential is moderate in the surface and subsurface layers and high in the subsoil. The organic matter content is moderate, and natural fertility is medium.

Nearly all areas of this soil are in wetland vegetation and native grass. These areas are used as wildlife habitat and for grazing or hay. Other areas are farmed.

This soil is generally very poorly suited to dryland farming. In dry years grain sorghum can be grown, but in most years crops are lost because of flood damage. Following heavy rains, runoff from adjacent areas saturates the surface layer; because there are no natural outlets, water is ponded for several weeks or months until it evaporates or until it is slowly absorbed by the soil. This soil is difficult to cultivate because of the excess water and because clayey material from the subsoil is mixed with the thin surface layer in places. Soil blowing may be a hazard in dry years.

This soil is unsuited to irrigation. It is ponded for long periods.

This soil is generally unsuited to use as rangeland or for native hay. The native grass community is not very productive because of periodic ponding and inundation. A boggy condition develops from livestock compaction if this soil is grazed when it is too wet. Overgrazing can reduce the already thin vegetation so much that the soil will blow in dry years. Dugout type reservoirs provide water for livestock and for recreation uses. The amount of refill depends on the amount of water obtained from precipitation or from runoff of irrigation water from higher, adjacent areas.

This soil is unsuited to growing trees in windbreaks. Some areas can be used for recreation, forestation, and wildlife plantings. Some trees naturally become established along the outer boundary of the mapped area. Only trees that can tolerate long or very long periods of ponded water are suited to this soil.

This soil is suited to wetland wildlife habitat. Potential is poor for grain and seed crops, grasses and legumes, and wild herbaceous plants. However, higher, adjacent areas can provide food, shelter, and nesting areas for wildlife. Potential for wetland plants is good. Vegetation includes perennial forbs, such as ironweed and smartweed; perennial grasses, such as Canada wildrye and barnyard grass; and annual forbs, such as ragweed and sedges. Waterfowl, such as geese and ducks, are the main wildlife of this habitat. Openland wildlife, such as pheasants, use this habitat for shelter in dry seasons and in wet seasons when ponded water is frozen in winter. Hunting is the main recreation use, but it is sometimes limited. Although potential for shallow water areas is good, dry summers and dry falls contribute to dry basins, which waterfowl bypass.

Ponding for long periods and very slow permeability cause this soil to be too wet for sanitary facilities and building sites. Suitable sites can be located on more permeable, higher, adjacent soils that are not subject to ponding. The ponding hazard, high frost action potential, and low strength of this soil limit its use for roads and streets. Building roads on suitable, raised, well compacted fill material helps to overcome these limitations.

This soil is in capability unit IVw-2, dryland, and windbreak suitability group 10. It is not assigned to a range site.

UyE2—Uly silt loam, 11 to 17 percent slopes, eroded. This deep, moderately steep, somewhat excessively drained soil is mostly on the short, steep sides of upland drainageways. A few areas are on terrace breaks or the sides of drainageways crossing terraces. Rills and gullies are common in this eroded soil. Individual areas range from 5 to about 80 acres.

Typically, the surface layer is brown, friable silt loam about 5 inches thick. The subsoil is about 5 inches thick. It is brown, friable silt loam. The underlying material is pale brown, calcareous silt loam to a depth of 60 inches. In most areas, erosion has removed all of the original, dark surface layer and most of the subsoil. In some areas the surface layer and subsoil are silty clay loam. Also, in some areas the surface is calcareous.

Included with this soil in mapping, and making up 20 percent or less of the map unit, are small areas of eroded Geary and Hobbs soils. Geary soils are on the short, moderately steep and steep sides of drainageways at mostly lower elevations than this Uly soil. Hobbs soils are on the narrow bottoms of drainageways.

Permeability is moderate, and available water capacity is high in this Uly soil. Moisture is released readily to plants. Runoff is rapid. Tilth is poor. The organic matter content and natural fertility are low. The shrink-swell potential is moderate in the surface layer and subsoil but low in the underlying material.

Nearly all areas of this soil are farmed. A few areas have been reseeded to native or tame grasses and are used for grazing or hay.

This soil is unsuited to dryland and irrigated farming because of the steep slopes and the severe hazard of erosion. The cultivated areas need to be reseeded to native grass. Tame grasses for pasture are poorly suited to this soil because they usually provide less vegetative cover for controlling erosion. A few of the less sloping areas are suited to native hay.

This soil is suited to use as rangeland. Overgrazing causes erosion, especially on the steep slopes. Leaving about half of the grass at all times helps to slow the runoff and protect the soil. The correct placement of fences, livestock watering developments, and salting facilities in pasture can insure the proper distribution of livestock. Earth dams and excavated ponds can be installed to provide water for livestock and for recreation uses as well as to control runoff. Conservation land treatment measures should be applied to areas above these structures to prevent sediment from limiting their period of use.

This soil is poorly suited to growing trees in windbreaks. Tree planting with machinery is difficult on the steep slopes.

Excessive slope limits the use of the soil for dwelling and building sites and sanitary facilities. More suitable sites for these uses are on some of the less sloping soils that are included in or adjacent to this map unit. Dwellings and buildings need to be properly designed to accommodate the slope, or the soil can be graded. Cuts and fills are needed in places to provide a suitable grade for roads. Road cuts should be seeded to protective vegetative cover. Adequate culverts and bridges are needed because of excess runoff.

This soil is in capability unit VIe-8, dryland; the Silty range site; and windbreak suitability group 3.

UyF—Uly-Hobbs silt loams, 0 to 30 percent slopes. This map unit consists of deep, steep, somewhat excessively drained soils mostly on uplands and deep, nearly level and very gently sloping, well drained soils on bottom lands along intermittent streams. Individual areas range from 5 to about 200 acres. This map unit is 50 to 70 percent Uly soil and 30 to 50 percent Hobbs soil. The Uly soil is mostly on short, steep sides of upland drainageways. A few areas are on terrace breaks or the sides of drainageways crossing terraces. The Hobbs soil is on the narrow bottoms of channeled and occasionally flooded drainageways. Areas of the two soils are so narrow and long that it is not practical to map them separately.

Typically, the Uly soil has a surface layer of grayish brown, very friable silt loam about 8 inches thick. The subsoil, about 15 inches thick, is friable silt loam. It is brown in the upper part, pale brown in the middle part, and very pale brown and calcareous in the lower part. The underlying material is very pale brown, calcareous silt loam to a depth of 60 inches. In some areas the surface layer is less than 6 inches thick. The subsoil, in places, is more than 29 percent clay. It is exposed at the surface on small eroded areas that have been overgrazed or cultivated and on catsteps where the soil has been eroded.

Typically, the Hobbs soil has a stratified surface layer of grayish brown and brown, very friable silt loam about 9 inches thick. The underlying material to a depth of 60 inches is stratified, grayish brown and pale brown silt loam in the upper part; dark grayish brown, buried silt loam in the middle part; and pale brown silt loam in the lower part. In some areas the surface layer or the underlying material, or both, are silty clay loam.

Included with these soils in mapping, and making up 20 percent or less of the map unit, are small areas of Geary and Holder soils. Geary soils are on the short, steep sides of drainageways at mostly lower elevations than the Uly soil. Holder soils are on gently sloping to strongly sloping sides of drainageways.

Permeability is moderate, and available water capacity is high in the Uly and Hobbs soils. Tilth is good in these very friable soils. The Uly soil has moderately low organic matter content and medium natural fertility. The Hobbs soil has moderate organic matter content and high natural fertility. The shrink-swell potential in the Uly soil is moderate in the surface layer and subsoil but low in the underlying material. It is low in the Hobbs soil.

Nearly all areas of these soils are in native grass and used for grazing or hay. A few areas are farmed.

The soils in this map unit are unsuited to dryland farming and to irrigated farming because of the steep slopes and the severe hazard of erosion. The few cultivated areas need to be reseeded to native grass. Tame grasses for pasture are somewhat unsuited to the Uly soil because they usually provide less vegetative cover to prevent erosion. A few of the less sloping areas are suited to native hay.

The Uly and Hobbs soils are suited to use as rangeland. Overgrazing causes erosion, especially on the

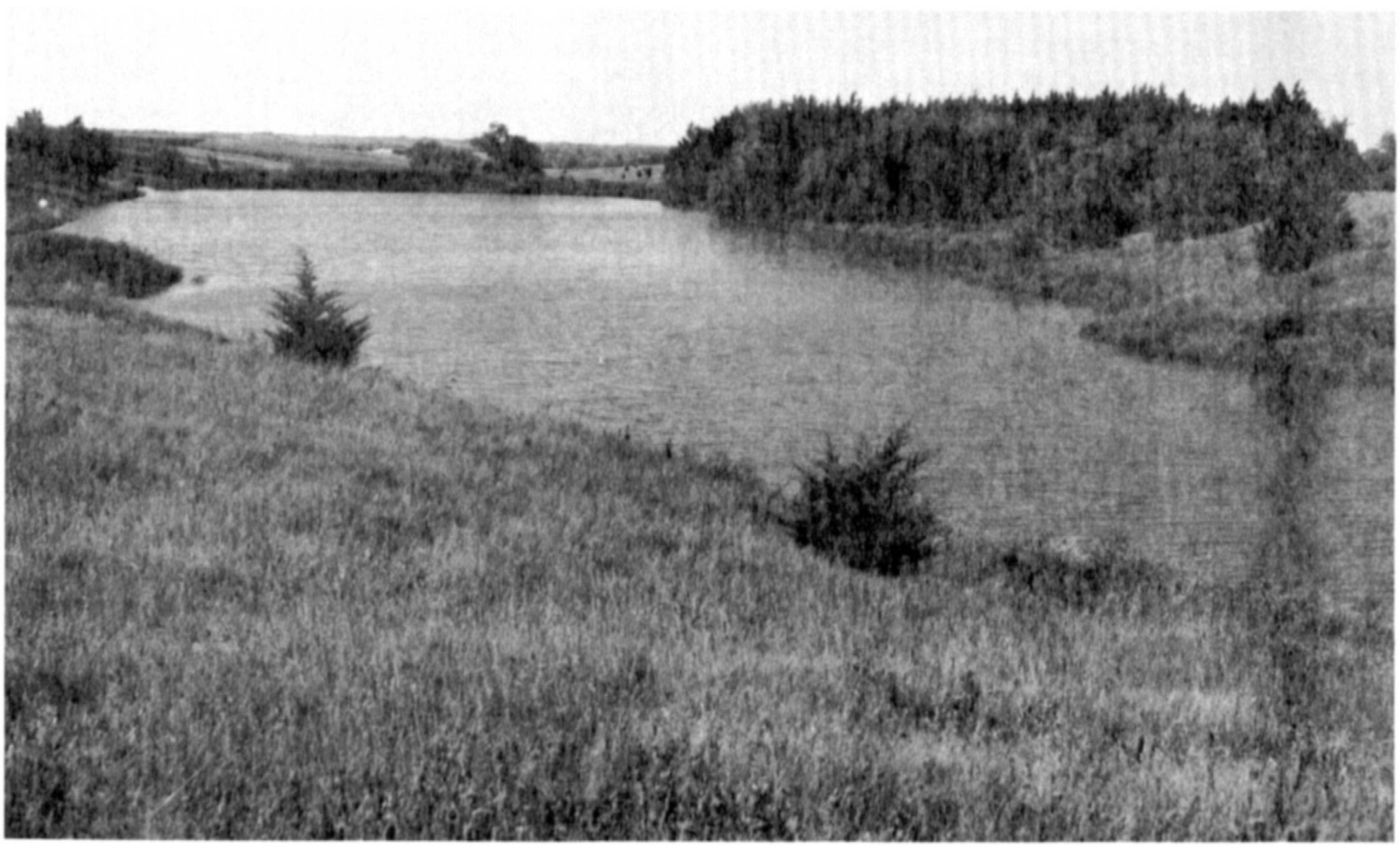

Figure 16.—Native grasses, wildlife plantings, and the reservoir control runoff and erosion on this rangeland site of Uly-Hobbs silt loams, 0 to 30 percent slopes.

steep slopes. Leaving about half of the grass ungrazed helps to maintain the plant cover, slow runoff, and protect the soil. The correct placement of fences, livestock watering developments, and salting facilities in pastures can insure the proper distribution of livestock. Reseeding or interseeding may be needed if the native plant community has deteriorated for many years.

Occasional flooding on the bottom land areas causes sedimentation and the introduction of weeds. Weeds should be controlled so that the desirable grasses can reseed. Meandering channels often develop where the flow of water is strongest and of the longest duration.

Earth dams and stream-fed excavated ponds can be installed to provide water for livestock, irrigation, and for recreation uses as well as to control runoff (fig. 16). Conservation land treatment measures should be applied to areas above these structures to prevent sedimentation from limiting their period of use.

The soils in this unit are generally unsuited to growing trees in windbreaks. Tree planting with machinery is difficult and can cause erosion on the steep slopes and on the narrow, possibly gullied bottom lands.

The soils in this map unit either have excessive slopes or are occasionally flooded. These limitations make the soils generally unsuited to septic tank absorption fields, sewage lagoons, and dwelling and building sites. Extensive cuts and fills on the steep slopes are needed to provide a suitable grade for local roads. On the narrow flood plains, roads need to be constructed on suitable compacted fill material, and adequate side ditches and culverts are needed to protect roads from flood damage. Low strength is a limitation for roads, but this limitation can be overcome by strengthening or replacing the base material. Road cuts should be seeded with protective vegetative cover to prevent erosion. Adequate culverts and bridges are needed to prevent damage from excess runoff.

These soils are in capability unit VIe-1, dryland. The Uly soil is in the Silty range site, and the Hobbs soil is in the Silty Overflow range site. These soils are in windbreak suitability groups 10 and 1, respectively.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and windbreaks; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

William E. Reinsch, conservation agronomist, Soil Conservation Service, helped to write this section.

Most of the agricultural land in Clay County is used as cropland. According to the Nebraska Agriculture Census Statistics, 81 percent of the total farmland is planted to crops. The largest acreage is in corn and sorghum, followed by small grain. Other crops are alfalfa and soybeans. About 58 percent of the cropland is irrigated.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

dryland farm management

Good management practices on dryland farmed cropland are those that reduce runoff and the hazard of erosion, conserve moisture, and improve tilth. Most of the soils in Clay County are suited to crop production. In many places, however, the hazard of erosion is severe and should be reduced by using suitable conservation practices.

Terraces, contour farming, grassed waterways, and conservation tillage systems that keep crop residue on the surface help to reduce water erosion. Keeping crop residue on the surface or growing a protective plant cover reduces the crusting of the soil during and after heavy rains. In winter, stubble catches drifting snow that can provide additional moisture. Crop residue is also a stable bank of plant nutrients that can not be lost through leaching or volatilization.

The hazard of soil blowing in Clay County is minor, but the same management practices that control water erosion can be used to control soil blowing. Examples of these practices are returning crop residue to the soil, using conservation tillage, contour stripcropping, and growing narrow field windbreaks. The overall hazard of erosion could be reduced if areas of the more productive soils were used for row crops and the steeper, more erodible soils were used for close grown crops, such as small grain and alfalfa, or for hay and pasture. Proper land use alone can reduce the hazard of erosion in many places.

In Clay County, rainfall is the limiting factor for crop production. Where wind and water act as erosive forces to the soil, an appropriate cropping system should be planned.

The sequence of crops grown in a field in combination with the practices needed for the management and conservation of the soil is known as a cropping system. On dryland farmed soils, the cropping system should preserve tilth and fertility, maintain a plant cover that protects the soil from erosion, and control weeds, insects, and diseases. Cropping systems vary according to the soils on which they are used. For example, the crop sequence on Holder silty clay loam, 6 to 11 percent slopes, eroded, should include a high percentage of grass and legume crops. On Hall silt loam, 0 to 1 percent slopes, however, a higher percentage of row crops can be grown in the cropping sequence and still maintain the fertility and tilth of the soil.

In dryland farming, soils need to be worked to prepare a seedbed, to control weeds, and to provide a favorable place for plants to grow. Excessive tillage, however, breaks down the granular structure in the surface layer that is needed for good soil tilth. Steps in the cultivation process should be limited to those that are essential. Various methods of conservation tillage are used in Clay County. The conservation tillage system of till-plant and disc or chisel and plant is well suited to row crops. Grasses can be established by drilling into a cover of stubble without further seedbed preparation.

All soils that are used for cultivated crops or for pasture should be tested to determine their nutrient deficiencies. Under dryland management, the kind and amount of fertilizer to be applied should be based on the results of soil tests and on the content of moisture in the soil at the time of application. If the subsoil is dry and rainfall is low, the rate at which fertilizer is applied should be slightly lower than if the soil were moist. For non-legume crops, nitrogen fertilizer is beneficial on all soils. Phosphorus and zinc are needed on the more eroded soils or on cut areas after construction of terraces or diversions. Dryland farmed soils need smaller amounts of fertilizer because there are generally fewer plants.

The best management practices for protecting against and reducing the hazard of erosion on soils of class I and subclasses IIw and IIIw are using crop residue, applying fertilizer or barnyard manure, and using good agronomy practices. On soils of subclasses IIe and IIs the best practices are leaving crop residue on the soil throughout winter, contour farming, using grassed waterways, and using a conservation tillage system that leaves 3,000 pounds per acre of corn or sorghum residue or 1,500 pounds per acre of small grain residue on the soil after the crop is planted. On soils of subclasses IIIe and IVe the management practices are leaving crop residue on the soil throughout winter; contour farming; and using terraces, grassed waterways, and a conservation tillage system that leaves 3,000 pounds per acre of corn or sorghum residue or 1,500 pounds per acre of small grain residue on the soil after the crops are planted. If slopes are more than 10 percent, grasses and legumes are needed in the cropping sequence to reduce water erosion to an acceptable level.

Fillmore and Scott soils are subject to ponding. If the water can not be lowered sufficiently for good crop growth, crops that tolerate wetness can be planted.

Using herbicides is an excellent way to control weeds; however, care should be taken to apply the correct kind at a rate based on the soil conditions. The colloidal clay and humus fraction is responsible for the greatest part of the chemical activity in the soil. Therefore, crop damage from an excess of herbicides can occur in areas where the organic matter content is moderately low to low. Application rates of herbicides should be correspondingly lowered on these soils. Farming on the contour helps to maintain the organic matter content, thereby lessening the danger of damage by herbicides.

Irrigation management

About 58 percent of all cropland in Clay County is irrigated. Corn is grown on 74 percent of the irrigated cropland, with a smaller acreage in alfalfa, hay, and sorghum.

The irrigation water is obtained almost entirely from wells. Either furrrow or sprinkler systems are suited to corn, sorghum, and soybeans. Alfalfa can be irrigated by the border, contour ditch, corrugation, or sprinkler system.

The cropping system on soils that are well suited to irrigation consists mostly of row crops. A cropping sequence that includes different row crops, such as small grain and alfalfa or grass, helps to control the cycle of disease and insects that are commonly present if the same crop is grown year after year. Gently sloping soils, such as Hastings silt loam, 3 to 6 percent slopes, are subject to water erosion if they are furrow irrigated down the slope. If furrow irrigation is used, the gently sloping soils can be contour bench leveled or irrigated with contour furrows in combination with parallel terraces.

Land leveling has increased the efficiency of irrigation because an even distribution of water can be obtained. The efficiency of a furrow irrigation system can be improved by adding a tailwater recovery system. Terraces, contour farming, and contour bench leveling can be used on irrigated land, in addition to contour furrows with terraces. Grassed waterways and conservation tillage practices that keep crop residue on the surface help to control water erosion on soils irrigated by the sprinkler system.

If the sprinkler irrigation system is used on such soils as Hastings silt loam, 3 to 6 percent slopes, and Holder silt loam, 6 to 11 percent slopes, the conservation practices that were used to control water erosion on nonirrigated cropland should be applied. These practices include using terraces, contour farming, and leaving a protective cover of crop residue on the soil after the row crop is planted. These practices are important for conserving the supply of surface water and for protecting the soil against erosion.

In the sprinkler irrigation system, water is applied by sprinklers at a rate at which the soil can absorb it without runoff. Sprinklers can be used on the more sloping soils as well as the nearly level ones. Some soils, such as Hastings silt loam, 3 to 6 percent slopes, are suited to sprinkler irrigation if conservation practices that control erosion are used. Because the water can be carefully controlled, sprinklers have special use in conservation, such as establishing new pasture on moderately steep slopes. In summer, however, much water is lost through evaporation. Wind drift can cause uneven application of water with some sprinkler irrigation systems.

Two general kinds of sprinkler systems are those that operate in sets, which means they are placed in a certain location and operate there until a specified amount of water is applied; and the center-pivot type, which is a moving sprinkler system that revolves about a central pivot point.

Soil can hold only a limited amount of water. Irrigation water, therefore, is applied at regular intervals to keep the soil profile moist at all times. The interval varies according to the crop and the time of year. Water should be applied only as fast as the soil can absorb it.

Irrigated silt loam and silty clay loam soils in Clay County hold about 2 inches of available water per foot of soil depth. A soil that is 4 feet deep and planted to a crop that sends its roots to that depth can hold about 8 inches of available water for that crop.

Maximum efficiency of furrow irrigation is obtained if the irrigation process is started when about one-half of the stored water has been used by the plants. Thus, if a soil holds 8 inches of available water, irrigation should be started when about 4 inches have been removed by the crop. Irrigation sets or systems should be planned to replace the amount of water that is used by the crop.

A tailwater recovery pit can be installed at the end of a furrow irrigated field to trap runoff of excess irrigation tailwater. This water can then be pumped to the upper ends of the field and used again. This practice increases the efficiency of the irrigation system and helps to conserve the supply of underground water.

All of the soils in Nebraska are placed in irrigation design groups. These design groups are described in the Irrigation Guide for Nebraska, which is part of the technical specifications for conservation in Nebraska (*11*). Arabic numbers of the irrigation capability unit indicate the irrigation design group to which the soils belong.

Assistance in planning and designing an irrigation system is available through the local office of the Soil Conservation Service or the county agricultural agent. Estimates concerning cost of equipment can be obtained from local dealers and manufacturers of irrigation equipment.

managing pasture and hayland

Areas that are in hay or pasture should be managed for maximum production. Once the pasture is established, the grasses should be kept productive. A rotation grazing system that meets the needs of the plants and promotes uniform utilization of forage is important if high returns are expected. Many forages are a good source of minerals, vitamins, proteins, and other nutrients. A well managed pasture can thus provide a balanced ration throughout the growing season. Irrigated pasture needs a high level of management if it is to produce maximum returns.

A mixture of grasses and legumes, if properly managed, can be profitably grown on many kinds of soils. Such a mixture is compatible with grain crops in a crop rotation and has beneficial soil building effects. Because grasses and legumes improve tilth, add organic matter, and reduce erosion, they are ideal for use in a conservation cropping system.

If grasses and legumes are used for pasture and hayland, on both dryfarmed and irrigated soils, they need additional plant nutrients to obtain maximum production. The kinds and amount of fertilizer needed should be determined by a soil test.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-8.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

This section was prepared by Peter N. Jensen, range conservationist, Soil Conservation Service.

Rangeland accounts for approximately 12 percent of the total agricultural land in Clay County. It is largely in the drainageways and on side slopes along the Little Blue River, the West Fork of the Big Blue River, School Creek, Little Sandy Creek, and Big Sandy Creek. Rangeland is common in the Holder-Uly, Hastings-Uly, and Geary-Holder-Uly associations. Another area is in the Meat Animal Research Center. The majority of the rangeland is in the Silty, Clayey, Silty Overflow, and Clayey Overflow range sites.

The average size of a livestock farm in Clay County is about 480 acres. Raising livestock, mainly cow and calf herds, with calves sold in fall as feeders, is the second largest agricultural industry in the county. The rangeland is generally grazed late in spring to early in fall. The livestock spend the rest of the year grazing corn or grain sorghum aftermath, or both, in fall and early in winter. They are fed alfalfa hay, native grass hay, forage sorghum, silage, or any combination of these for the rest of the winter.

Some of the rangeland has been depleted by overuse. The overused pastures support low forage producing plants. Commonly, these pastures have an abundance of broadleaf weeds. The productivity of the range can be increased by proper management practices, such as proper grazing; rest or deferment of grazing; a planned grazing system of use and rest; and brush or weed control, or both. Some pastures are depleted to the point where reseeding or renovation is needed to restore productivity.

At the end of each map unit description, the soil or soils in that unit are placed in an appropriate range site according to the kind and amount of vegetation that is grown on the soil if the site is in excellent range condition. The interpretations for each range site in the county are in the technical guide, which can be obtained from the local office of the Soil Conservation Service. Livestock farmers or others who want technical help with reseeding cropland to rangeland, with setting up a planned grazing system, or with other aspects of a range program should contact the local office of the Soil Conservation Service.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 7 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of water erosion and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

windbreaks and environmental plantings

Keith A. Ticknor, forester, Soil Conservation Service, helped to write this section.

A good windbreak should be designed to fit the soil in which it is to grow. The intended purpose of the planting should always be considered. Although trees and shrubs are not easily established every year in Clay County, the observance of good tree culture can result in a high degree of survival.

The conifers, cedar and pine, are better suited to windbreaks than other trees. Both are rated high in vigor and survival. They hold their leaves throughout the winter, thereby giving maximum protection when it is needed.

On all soils, weeds and undesirable grasses can be controlled by cultivating between the rows with conventional equipment, such as a disc. Hand hoeing or careful use of an appropriate herbicide can be used in the area between the rows.

Windbreaks protect livestock, buildings, and yards from wind and snow (fig. 17). They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock

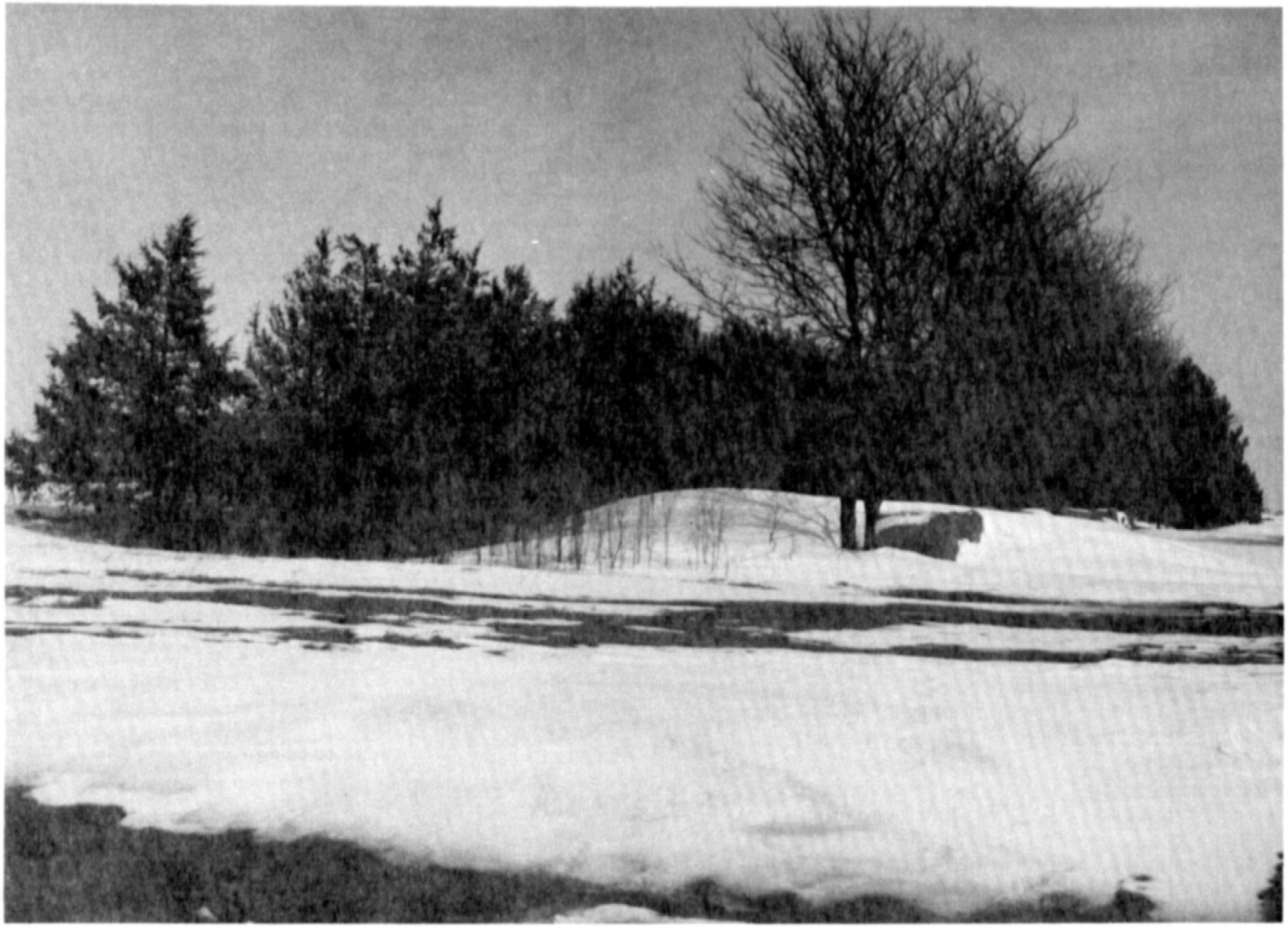

Figure 17.—This windbreak intercepts wind and snow on Crete silt loam, 0 to 1 percent slopes.

of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens.

Newly planted trees and seedlings may need watering if they are to become well established. Even when the trees are larger, they may need supplemental water during seasons when natural precipitation is low.

At the end of each map unit description, the soil in that unit is placed in an appropriate windbreak suitability group on the basis of the adaptability of the particular species of tree or shrub as indicated by growth and vigor. Soils in windbreak suitability group 10 are generally not suited to growing trees and shrubs in windbreaks because of their unfavorable qualities. However, some areas can be used for recreation, forestation, or plantings for wildlife habitat if tolerant species of trees and shrubs are hand planted or if special practices are used to care for them. Interpretations for each windbreak suitability group in the county are available.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

Robert O. Koerner, biologist, Soil Conservation Service, helped to prepare this section.

Recreation in Clay County consists of hunting for pheasant, waterfowl, mourning dove, and deer during the appropriate seasons; fishing for bass and bluegill in farm ponds and for catfish in the Little Blue River; and hiking and birdwatching.

In order to provide for the demand for outdoor recreation, the U.S. Department of Interior, Fish and Wildlife Service, has designated 13 areas, which consist of approximately 1,953 acres of water and 2,294 acres of adjacent upland, for public recreation uses.

The Oregon Trail near Spring Ranch and the town of Deweese are of historical interest to tourists and residents.

Technical assistance is available for designing installations to improve wildlife habitat as well as facilities for recreation within Clay County. The Soil Conservation Service has a field office in Clay Center and can provide this assistance, or they can direct applicants to the appropriate federal or state agency that can provide the needed assistance.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are big and little bluestem, goldenrod, giant ragweed, western wheatgrass, and sideoats grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are bur oak, cottonwood, greenash, honeylocust, mulberry, black walnut, boxelder, gooseberry and wild grape. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are honeysuckle, autumn-olive, and cotoneaster.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are American plum, chokecherry, snowberry, and sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild flax, reed canarygrass, rushes, sedges, and cattails.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include owls, hawks, songbirds, woodpeckers, squirrels, opossum, raccoon, deer, and skunks.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include white-tailed deer, pheasant, prairie dog, and meadowlark.

wildlife in the associations

In the following paragraphs, the nine associations in Clay County are discussed in relation to the kinds of wildlife they support.

The Hall-Hastings and the Crete-Hastings associations mainly support openland wildlife. Cropland is the major land use. Nesting cover and winter cover are limited for upland game species. Farmstead windbreaks supply some of the needed winter cover.

The Hastings-Uly association consists of scattered patches of grassland. Rangeland wildlife, such as pocket gophers, ground squirrels, and other rodents, are prevalent.

Both dryland and irrigated crops provide summer food and cover for many species of wildlife. The lack of undisturbed nesting cover is a limitation for increasing the populations of pheasant and bobwhite quail. Including crops such as alfalfa in the cropping sequence helps to provide more nesting cover.

There are scattered clumps of redcedar, plum, and chokecherry in the drainageways and on hillsides. These surroundings attract mourning dove and songbirds for food, cover, and nesting.

The Hastings-Uly association also provides travel lanes for wildlife to move between the Hord-Hobbs association and the upland associations.

The Hord-Hobbs association consists of bottom lands adjacent to the major streams. This association provides food in the form of grain that is left in the field after harvest for bobwhite quail, pheasant, and white-tailed deer. The streambanks and woody vegetation provide cover, and the streams provide water.

The Hastings-Crete-Butler association and the Hastings-Massie association make up the largest acreage of the county. The land is predominantly used as cropland. These associations contain a large diversity of cover types. Scattered throughout are many wetlands, or potholes. Included in these associations are several national wildlife areas managed by the U.S. Fish and Wildlife Service. These wetlands and adjacent lands provide resting places for migratory waterfowl as well as local nesters (fig. 18).

These wetlands also provide excellent refuge and nesting cover for pheasant and bobwhite quail. Predator species, such as fox, coyote, and badger, are attracted to the areas by the presence of the upland game birds.

The Holder-Uly association and the Geary-Holder-Uly association contain a mixture of grassland and cropland, depending on the slopes. Rangeland wildlife, such as prairie dogs and other rodents, are found in these

Figure 18.—Many times the only water areas available for waterfowl use during spring migration are the irrigation tailwater recovery pits as shown in this area of Fillmore soils. By dispersing the ducks and geese over a broader area, the problem of disease is lessened.

associations. The grasses also provide nesting areas for pheasants and quail.

The Hord-Cass-Hobbs association is in the extreme southwest corner of the county on bottom lands along the Little Blue River. The Little Blue River is the only true river ecosystem in the county. It is a flowing stream and provides habitat for woodland species of wildlife, such as white-tailed deer, tree squirrels, raccoon, and songbirds. It also creates an edge effect between the woodland and cropland, which is used as habitat by the bobwhite quail. This association contains the greatest diversity of cover types and, therefore, supports more wildlife species per acre than any of the other associations in the county.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 18.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 18.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69.

The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations generally can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

engineering index test data

Table 18 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by the State of Nebraska, Department of Roads.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Particle density (T 100-57). The group index number, which is a part of the AASHTO classification, is computed using the Nebraska Modified System.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*12*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 19, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittently dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizonation, plus *ustoll*, the suborder of the Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*10*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*12*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Butler series

The Butler series consists of deep, somewhat poorly drained soils on uplands and stream terraces. Permeability is slow. The soils formed in loess. Slope is 0 to 1 percent.

Butler soils are commonly adjacent to Crete, Fillmore, Hastings, and Scott soils. Crete and Hastings soils do not have an A2 horizon and are on higher elevations than the Butler soils. Fillmore and Scott soils have an albic horizon and are in depressions. Scott soils also have a thinner A1 horizon.

Typical pedon of Butler silt loam, 0 to 1 percent slopes, 790 feet north and 300 feet west of the southeast corner of sec. 29, T. 6 N., R. 5 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A12—6 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable; medium acid; abrupt smooth boundary.

A2—10 to 11 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium platy structure parting to weak fine granular; soft, very friable; slightly acid; abrupt smooth boundary.

B21t—11 to 22 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; strong coarse prismatic structure parting to strong medium angular blocky; very hard, very firm; thin shiny surfaces on most peds, few fine dark concretions (iron and manganese oxides); neutral; gradual smooth boundary.

B22t—22 to 31 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong coarse prismatic structure parting to strong coarse angular blocky; very hard, very firm; shiny surfaces on most peds, few fine dark concretions (iron and manganese oxides); mildly alkaline; clear smooth boundary.

B3—31 to 38 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; few fine distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; common soft accumulations of calcium carbonate; strong effervescence (2 percent calcium carbonate); mildly alkaline; gradual smooth boundary.

C1—38 to 49 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (10YR 4/2) moist; few fine distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; soft accumulations of calcium carbonate; slight effervescence (1 percent calcium carbonate); mildly alkaline; gradual smooth boundary.

C2—49 to 60 inches; light brownish gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; few fine distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, very friable; few soft accumulations of calcium carbonate; strong effervescence (2 percent calcium carbonate); mildly alkaline.

The thickness of the solum ranges from 30 to 44 inches, and the depth to free carbonates ranges from 26 to 38 inches.

The Ap horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. The A2 horizon has value of 4 through 6 (3 or 4 moist) and chroma of 1. The B2t horizon has hue of 10YR or 2.5 Y, value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It is silty and averages from 45 to 55 percent clay.

The C horizon has hue of 2.5Y or 5Y, value of 5 through 7 (4 or 5 moist), and chroma of 2 or 3. Reaction is mildly alkaline or moderately alkaline. Calcium carbonate also occurs as concretions, and the soil mass in between is generally noncalcareous.

Cass series

The Cass series consist of deep, well drained soils on bottom lands along perennial and intermittent streams. The soils formed in mixed, loamy or sandy alluvium. Permeability is moderately rapid in the upper part of the pedon and rapid in the lower part. Slope ranges from 0 to 2 percent.

Cass soils are commonly adjacent to Hobbs and Hord soils. Hobbs and Hord soils are in the fine-silty family, and Hord soils are on terraces.

Typical pedon of Cass silt loam, 0 to 1 percent slopes, 100 feet south and 140 feet west of the northeast corner of sec. 21, T. 5 N., R. 8 W.

A11—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A12—6 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable; neutral; gradual smooth boundary.

AC—12 to 17 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak thick platy structure parting to weak fine granular; slightly hard, very friable; neutral; gradual smooth boundary.

C1—17 to 29 inches; pale brown (10YR 6/3) very fine sandy loam, dark brown (10YR 4/3) moist; massive; loose; neutral; clear smooth boundary.

C2—29 to 36 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grain; loose; mildly alkaline; gradual smooth boundary.

C3—36 to 49 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; single grain; loose; mildly alkaline; gradual clear boundary.

IIC4—49 to 60 inches; very pale brown (10YR 6/3) coarse sand, brown (10YR 5/3) moist; single grain; loose; mildly alkaline.

The mollic epipedon ranges from 10 to 20 inches in thickness. The depth to free carbonates is typically more than 60 inches, but some pedons have a layer of carbonates below a depth of 25 inches.

The A horizon has chroma of 1 or 2. It is fine sandy loam or silt loam. Some pedons do not have an AC horizon. The C horizon has hue of 10YR or 2.5Y and chroma of 2 or 3. It is predominantly very fine sandy loam and fine sandy loam in the upper part and loamy fine sand in the lower part. Strata and horizons of sandier and loamier material are common. Below a depth of 40 inches, strata of gravelly sand are common but clayey material is not. Reaction is slightly acid or neutral.

Crete series

The Crete series consists of deep, moderately well drained soils on uplands (fig. 19). Permeability is slow. The soils formed in loess. Slope ranges from 0 to 3 percent.

Crete soils are commonly adjacent to Butler, Fillmore, Hastings, and Scott soils. Butler, Fillmore, and Scott soils have an abrupt boundary between the A and B horizons. Filmore and Scott soils are in depressions. Hastings soils have less clay in the B2t horizon than Crete soils.

Typical pedon of Crete silt loam, 0 to 1 percent slopes, 530 feet north and 100 feet west of the southeast corner of sec. 10, T. 7 N., R. 8 W.

Ap—0 to 6 inches; gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A12—6 to 10 inches; dark gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B1—10 to 13 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; faint gray coating on dry faces of peds; moderate fine and very fine subangular blocky structure; hard, friable; slightly acid; clear smooth boundary.

B21t—13 to 22 inches; brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; strong coarse prismatic structure parting to strong fine angular blocky; very hard, very firm; organic coatings on faces of peds; neutral; gradual smooth boundary.

B22t—22 to 28 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; strong coarse prismatic structure parting to strong fine angular blocky; very hard, very firm; organic coatings on faces of peds; neutral; gradual smooth boundary.

B3—28 to 32 inches; brown (10YR 5/3) silty clay loam; yellowish brown (10YR 5/4) moist; moderate fine and medium subangular blocky structure; hard, firm; many soft accumulations of calcium carbonate; violent effervescence (2 percent calcium carbonate); moderately alkaline; clear smooth boundary.

C—32 to 60 inches; pale brown (10YR 6/3) silt loam, light yellowish brown (2.5Y 6/4) moist; massive; slightly hard, very friable; few soft accumulations of

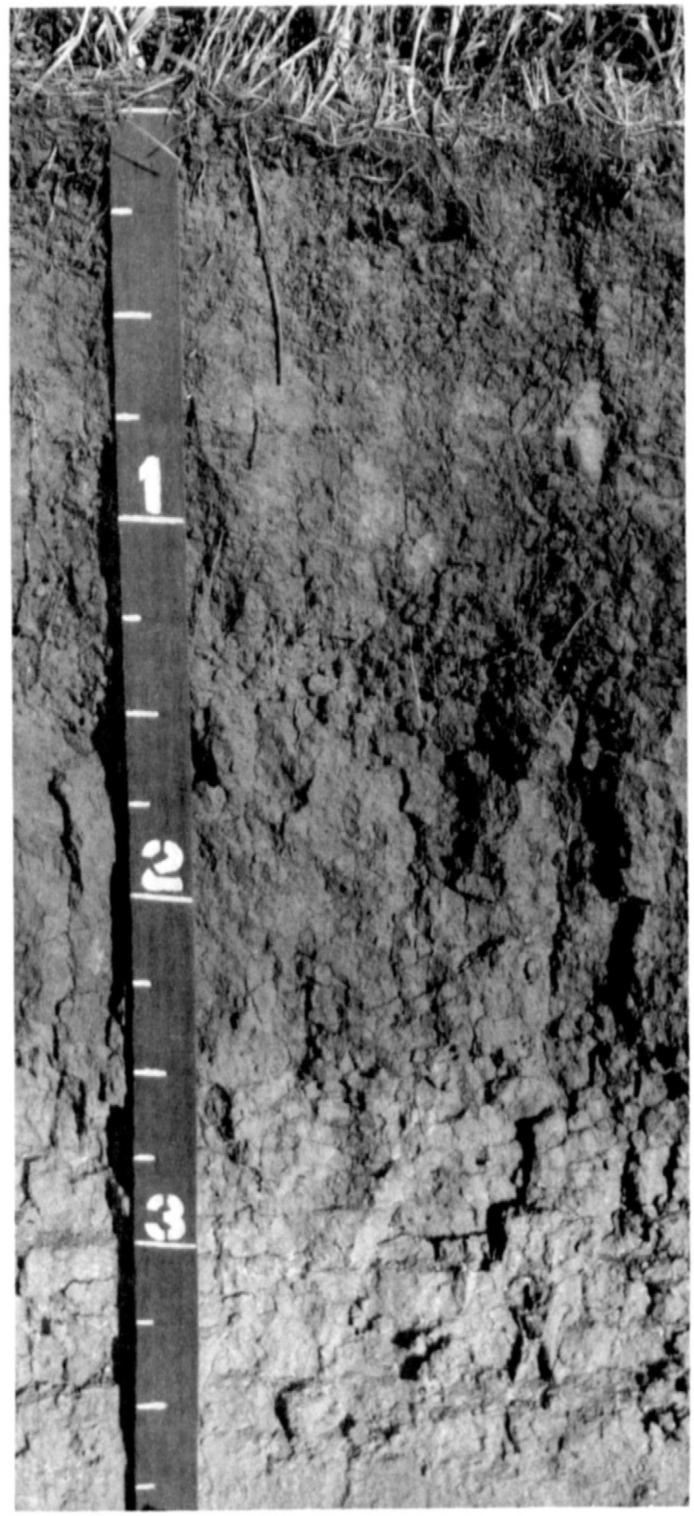

Figure 19.—Profile of Crete silt loam, 0 to 1 percent slopes. The prismatic and blocky structure of the claypan subsoil is not easily penetrated by plant roots, air, and water (scale in feet).

calcium carbonate; violent effervescence (2 percent calcium carbonate); moderately alkaline.

The thickness of the solum ranges from 30 to 46 inches. The depth to free carbonates ranges from 25 to 35 inches, but some pedons do not have carbonates. Thickness of the mollic epipedon ranges from 20 to 33 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. Reaction is medium acid or slightly acid. The upper part of the B2t horizon has value of 4 or 5 and chroma of 2 or 3. The lower part has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. The B2t horizon is silty clay and averages from 42 to 55 percent clay.

The B3 and C horizons have value of 5 through 7 (4 or 5 moist) and chroma of 2 through 4. Reaction is mildly alkaline or moderately alklaine. The C horizon is dominantly silt loam, but in some pedons it is silty clay loam. The B3 and C horizons are mottled in some pedons. Calcium carbonate is in the form of concretions in some pedons, and the soil mass between the concretions is generally noncalcareous.

Fillmore series

The Fillmore series consists of deep, poorly drained soils in shallow depressions or basins of uplands (fig. 20). Permeability is very slow. The soils formed in loess. Slope is less than 1 percent.

Fillmore soils are similar to Scott soils and are commonly adjacent to Butler, Crete, Hastings, Massie, and Scott soils. Butler soils do not have an albic horizon, are less poorly drained, and are in flat or slightly concave positions higher on the landscape than Fillmore soils. Crete and Hastings soils do not have an A2 horizon and are not in depressions. Massie soils have a solum that is thicker than that of the Fillmore soils. Also, they are ponded for longer periods, and the ponded water is deeper. Scott soils have thinner A1 and A2 horizons and are more poorly drained than Fillmore soils.

Typical pedon from an area of Fillmore silt loam, 0 to 1 percent slopes, 2,390 feet west and 275 feet north of the southeast corner of sec. 12, T. 6 N., R. 7 W.

A1—0 to 9 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak medium granular; slightly hard, friable; slightly acid; abrupt smooth boundary.

A2—9 to 13 inches; light gray (10YR 6/1) silt loam, gray (10YR 5/1) moist; weak medium platy structure parting to weak fine granular; soft, friable; slightly acid; few hard 1- to 2-millimeter (iron-manganese) pellets; abrupt smooth boundary.

B21t—13 to 24 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; strong coarse and medium angular blocky structure; very hard, very firm; shiny surfaces on most peds; many hard 1- to

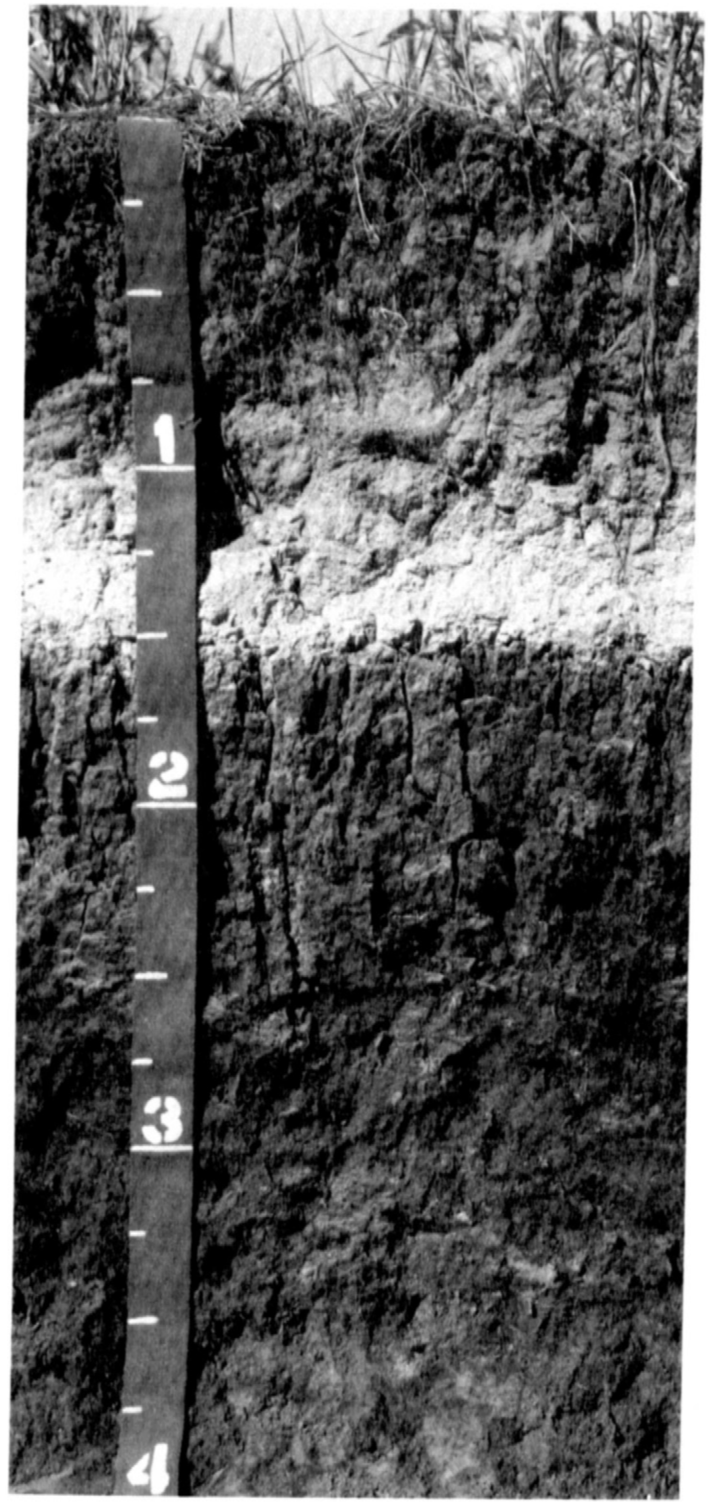

Figure 20.—Profile of Fillmore silt loam, 0 to 1 percent slopes. Clay has been leached from the light gray A2 horizon to the claypan subsoil below (scale in feet).

2-millimeter (iron-manganese) pellets; neutral; clear smooth boundary.

B22t—24 to 32 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong coarse and medium angular blocky structure; very hard, very firm; shiny surfaces on most peds; mildly alkaline; clear smooth boundary.

B3—32 to 44 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse and medium subangular blocky structure; hard, firm; mildly alkaline; gradual smooth boundary.

C—44 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; slight effervescence; moderately alkaline.

The thickness of the solum and depth to free carbonates range from 30 to 65 inches. A few pedons do not have carbonates to a depth below 70 inches.

The Ap horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. The A2 horizon has value of 5 through 7 (3 to 5 moist) and chroma of 1. It is dominantly silt loam, but the range includes silt. Reaction in the Ap and A2 horizons is medium acid or slightly acid. The B2t horizon has hue of 10YR or 2.5Y, value of 3 through 5 (2 or 3 moist), and chroma of 1 or 2. It is silty clay and averages from 45 to 55 percent clay.

The C horizon has hue of 10YR or 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4. It is silt loam or silty clay loam. It has soft accumulations or concretions of carbonates and is mottled in some pedons. Reaction is mildly alkaline or moderately alkaline. Concretions of iron and manganese oxides are in the B3 horizon and the upper part of the C horizon in some pedons.

Geary series

The Geary series consists of deep, well drained soils on uplands. Permeability is moderately slow. The soils formed in silty material presumed to be loess of the Loveland Formation. Slope ranges from 3 to 30 percent.

Geary soils are similar to Hastings and Holder soils and are commonly adjacent to Crete, Holder, Hord, and Uly soils. Unlike the Geary soils, these soils do not have hue as red as 7.5YR in the solum. Crete and Hastings soils have a fine argillic horizon. Crete and Hord soils are pachic and are more gently sloping. Hord soils are on foot slopes. Uly soils do not have an argillic horizon and are on steeper slopes.

Typical pedon of Geary silt loam, 6 to 11 percent slopes, 2,110 feet east and 75 feet north of the southwest corner of sec. 6, T. 5 N., R. 8 W.

A1—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable; slightly acid; gradual smooth boundary.

B1—9 to 13 inches; brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate fine and very fine subangular blocky structure; hard, friable; neutral; clear smooth boundary.

B21t—13 to 24 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm; neutral; gradual smooth boundary.

B22t—24 to 31 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; moderate medium prismatic structure parting to moderate coarse and medium blocky; very hard, firm; neutral; clear smooth boundary.

B3—31 to 40 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; weak medium and fine subangular blocky structure; hard, friable; mildly alkline; gradual smooth boundary.

C—40 to 60 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; few soft accumulations of carbonate; strong effervescence (1 percent calcium carbonate); mildly alkaline.

The thickness of the solum ranges from 30 to 45 inches, and the depth to free carbonates ranges from 40 to 60 inches or more. The mollic epipedon ranges from 10 to 20 inches.

The A horizon has value of 4 or 5 (3 moist) and chroma of 2 or 3. Reaction is slightly acid or neutral. The B2t horizon has chroma of 4 through 6. It is silty clay loam and averages from 27 to 35 percent clay. Organic coatings are generally present on faces of peds. Reaction ranges from slightly acid to mildly alkaline.

The C horizon has chroma of 4 through 6. Reaction is mildly alkaline or moderately alkaline. Sand grains are scattered throughout some pedons.

In map units GeC2, GeD2, and GeE2, the surface layer is slightly lighter in color than the defined range for the series, but this difference does not alter the usefulness or behavior of the soils.

Hall series

The Hall series consists of deep, well drained soils on uplands. Permeability is moderate. The soils formed in loess. Slope is 0 to 1 percent.

Hall soils are adjacent to Butler, Fillmore, Hastings, and Holder soils. Butler and Fillmore soils have abrupt increases in clay between the A and B horizons. Fillmore soils are in depressions. Hastings and Holder soils have a thinner mollic epipedon. Hastings soils are in the fine family.

Typical pedon of Hall silt loam, 0 to 1 percent slopes, 1,370 feet west and 100 feet north of the southeast corner of sec. 19, T. 5 N., R. 8 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A12—6 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; soft, very friable; slightly acid; clear smooth boundary.

B1—13 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium and moderate fine subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

B21—20 to 29 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure parting to moderate medium subangular blocky; slightly hard, firm; neutral; clear smooth boundary.

B22t—29 to 36 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure parting to moderate medium subangular blocky; slightly hard, firm; neutral; gradual smooth boundary.

B3—36 to 44 inches; pale brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; soft, friable; neutral; gradual smooth boundary.

C—44 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; neutral.

The thickness of the solum ranges from 30 to 54 inches. Carbonates are not present in most pedons. The thickness of the mollic epipedon ranges from 20 to 32 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. Reaction is slightly acid or medium acid. The B2t horizon is silty clay loam and averages from 28 to 35 percent clay. It has shiny surfaces and organic coatings on faces of most peds. Reaction is slightly acid or neutral. The C horizon is dominantly silt loam, but in some pedons it is silty clay loam. Reaction is neutral or mildly alkaline.

Hastings series

The Hastings series consists of deep, well drained soils on uplands. Permeability is moderately slow. The soils formed in loess. Slope ranges from 0 to 11 percent.

Hastings soils are commonly adjacent to Crete, Butler, Fillmore, Hall, and Holder soils. Crete soils are pachic and have more clay in the B2t horizon. Butler and Fillmore soils have abrupt increases in clay between the A and B horizons. Fillmore soils are in depressions. Hall and Holder soils are fine-silty. Hall soils are pachic.

Typical pedon of Hastings silt loam, 0 to 1 percent slopes, 400 feet west and 100 feet south of the northeast corner of sec. 11, T. 8 N., R. 5 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A12—6 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B1—10 to 15 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate very fine subangular blocky; slightly hard, friable; neutral; clear smooth boundary.

B21t—15 to 22 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate fine blocky; hard, firm; organic coatings on faces of peds; neutral; clear smooth boundary.

B22t—22 to 31 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium blocky; hard, firm; organic coatings on faces of peds; neutral; clear smooth boundary.

B3—31 to 38 inches; pale brown (10YR 6/3) silty clay loam, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable; neutral; clear smooth boundary.

C—38 to 60 inches; pale brown (10YR 6/3) silt loam, light olive brown (2.5Y 5/4) moist; few fine faint brownish yellow (10YR 6/6) mottles; massive; soft, very friable; few small soft accumulations of carbonate at a depth of about 60 inches; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 29 to 45 inches, and the depth to free carbonates ranges from 36 to 60 inches or more. The thickness of the mollic epipedon ranges from 11 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. Reaction is medium acid or slightly acid. The upper part of B2t horizon has chroma of 2 or 3. Reaction is slightly acid or neutral. The lower part of the B2t horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is silty clay loam or silty clay and averages from 35 to 42 percent clay. Organic coatings are present on faces of most peds. In some pedons, the B3 horizon has mottles similar to the C horizon. Reaction is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 6 or 7 (5 or 6 moist), and chroma of 2 through 4. It is dominantly silt loam, but in some pedons it is silty clay loam. Reaction is mildly alkaline or moderately alkaline.

In map units HdC2 and HdD2, the surface layer is slightly lighter in color and the subsoil is slightly thinner than is defined as the range from the Hastings series. However, these differences do not alter the usefulness or behavior of the soil.

Hobbs series

The Hobbs series consists of deep, well drained soils on bottom lands along intermittent and perennial streams. Permeability is moderate. The soils formed in noncalcareous, silty alluvium. Slope ranges from 0 to 3 percent.

Hobbs soils are commonly adjacent to Cass and Hord soils. Cass soils are coarse-loamy. Hord soils have a B horizon and are on stream terraces.

Typical pedon of Hobbs silt loam, 0 to 2 percent slopes, 960 feet west and 140 feet south of the northeast corner of sec. 15, T. 8 N., R. 8 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

C1—7 to 23 inches; stratified grayish brown (10YR 5/2) and brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) and dark brown (10YR 4/3) moist; weak medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

C2—23 to 37 inches; stratified gray (10YR 5/1) and grayish brown (10YR 5/2) silt loam, very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) moist; weak medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

C3—37 to 54 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

C4—54 to 60 inches; stratified brown (10YR 5/3) and pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) and brown (10YR 5/3) moist; weak fine granular structure; slightly hard, very friable; neutral.

The depth to free carbonates is 40 inches or more, except for some pedons which have a layer that contains free carbonates.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. Typically, it is silt loam and, less commonly, silty clay loam or fine sandy loam. Reaction is slightly acid or neutral. A buried A horizon is common. Stratification is apparent in undisturbed areas. The C horizon is dominantly silt loam, but in some pedons it is silty clay loam. Reaction ranges from slightly acid to mildly alkaline. Contrasting, thin strata of sandy or more clayey material are in some pedons.

Holder series

The Holder series consists of deep, well drained soils on uplands (fig. 21). Permeability is moderate. The soils formed in silty, calcareous loess. Slope ranges from 3 to 11 percent.

Holder soils are similar to Geary soils and are commonly adjacent to Crete, Geary, Hastings, Hord, and Uly soils. Crete and Hastings soils have a fine argillic

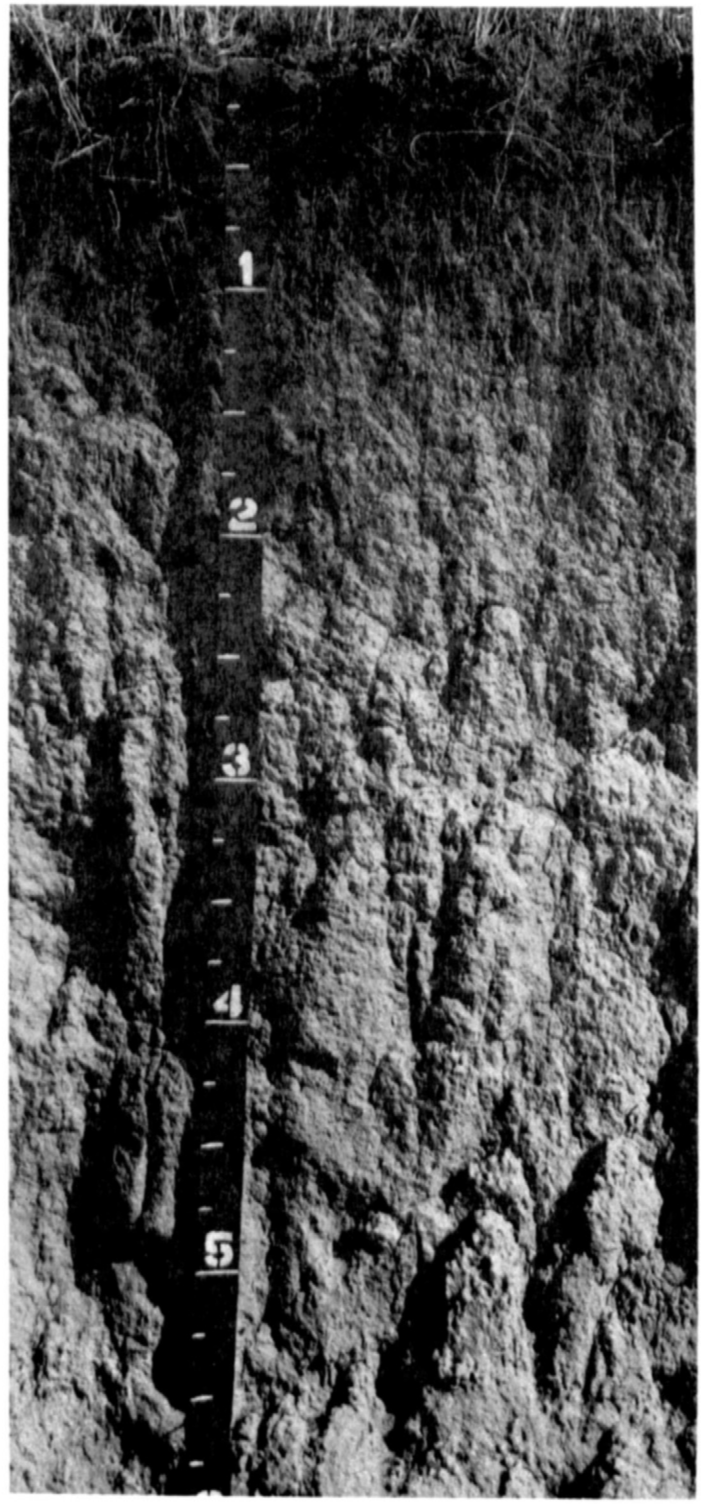

Figure 21.—Profile of Holder silt loam, 3 to 6 percent slopes. The prismatic and subangular blocky structure of the silty clay loam subsoil is easily penetrated by plant roots, air, and water (scale in feet).

horizon, and Crete soils have gentler slopes than Holder soils. Geary soils have redder hue in the subsoil. Hord and Crete soils are pachic, and Hord soils are on foot slopes. Uly soils do not have an argillic horizon and have steeper slopes.

Typical pedon of Holder silt loam, 3 to 6 percent slopes, 1,850 feet west and 40 feet north of the southeast corner of sec. 18, T. 5 N., R. 8 W.

A11—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

A12—5 to 9 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B1—9 to 14 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

B2t—14 to 26 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; neutral; clear smooth boundary.

B3—26 to 32 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; mildly alkaline; gradual smooth boundary.

C1—32 to 38 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; soft, very friable; mildly alkaline; clear smooth boundary.

C2—38 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; soft, very friable; few small soft accumulations of carbonate; strong effervescence (2 percent calcium carbonate); mildly alkaline.

The thickness of the solum ranges from 25 to 40 inches, and the depth to free carbonates ranges from 36 to 60 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. Reaction is medium acid or slightly acid. The B1 horizon is silt loam or silty clay loam. The B2t horizon has value of 4 through 6 (3 through 5 moist) and chroma of 3. It is silty clay loam and averages from 28 to 35 percent clay. The B3 horizon is silt loam or silty clay loam. The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 3. Reaction is mildly alkaline or moderately alkaline. The B3 and C horizons have brownish mottles in some pedons.

In map units HhC2 and HhD2, the surface layer is slightly lighter in color and the subsoil is slightly thinner than the defined range for the series, but this difference does not alter the usefulness or behavior of the soils.

Hord series

The Hord series consists of deep, well drained soils that formed in silty alluvium or loess (fig. 22).

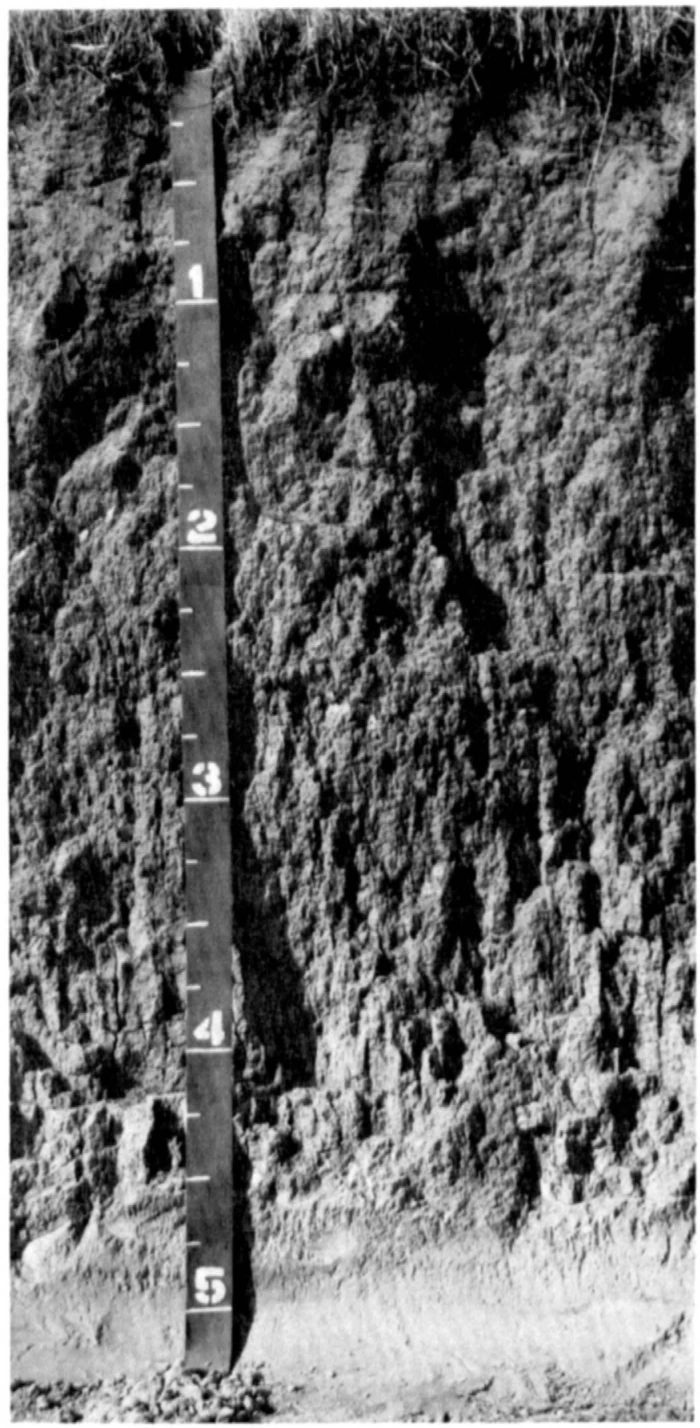

Figure 22.—Profile of Hord silt loam, 0 to 1 percent slopes. It is silt loam throughout, and darker buried layers are common (scale in feet).

Permeability is moderate. These nearly level to gently sloping soils are on high and low stream terraces and on colluvial foot slopes. Slope ranges from 0 to 3 percent.

Hord soils are adjacent to Cass, Hobbs, and Holder soils. Cass soils have coarser texture than Hord soils. Hobbs soils have more stratification and are on bottom lands. Holder soils have a thinner A horizon and a more developed B horizon.

Typical pedon of Hord silt loam, 0 to 1 percent slopes, 2,590 feet north and 100 feet west of the southeast corner of sec. 22, T. 8 N., R. 8 W.

Ap—0 to 8 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A12—8 to 16 inches; dark gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; soft, very friable; slightly acid; clear smooth boundary.

B2—16 to 30 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; neutral; gradual smooth boundary.

B3—30 to 48 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, friable; neutral; gradual smooth boundary.

Ab—48 to 55 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable; neutral; clear smooth boundary.

C—55 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; massive; soft, very friable; mildly alkaline.

The thickness of the solum ranges from 30 to 55 inches. The thickness of the mollic epipedon ranges from 20 to 40 inches.

The A horizon is dominantly silt loam, but the range includes loam and silty clay loam. Reaction is slightly acid or neutral. The upper part of the B horizon is similar in color to the A horizon and is dominantly silt loam, but in some pedons it is silty clay loam. The lower part of the B horizon has value of 4 through 6 (3 or 4 moist) and chroma of 2 or 3. It is dominantly silt loam but includes silty clay loam. An Ab horizon is absent in some pedons.

The C horizon is lighter in color than the B horizon. It is dominantly silt loam, but in some pedons it is very fine sandy loam or silty clay loam. It is commonly stratified. Free carbonates are absent in most pedons.

Massie series

The Massie series consists of deep, very poorly drained soils in the lower parts of upland depressions. Permeability is very slow. The soils formed in loess that had been modified by water action. Slope is less than 1 percent.

Massie soils are similar and commonly adjacent to Fillmore and Scott soils and are also commonly adjacent to Butler soils. Fillmore and Scott soils have a solum that is thinner than that of the Massie soils. Also, they are ponded for shorter periods and the ponded water is more shallow. Butler soils do not have an albic horizon and are in flat or slightly concave positions higher on the landscape than Massie soils.

Typical pedon from an area of Massie silty clay loam, 0 to 1 percent slopes, 630 feet north and 260 feet west of the southeast corner of sec. 24, T. 6 N., R. 6 W.

A11—0 to 3 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate medium granular structure; slightly hard, very friable; strongly acid; clear smooth boundary. On the surface is a layer of partially decayed leaves and stems.

A12—3 to 7 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak coarse platy structure parting to weak fine granular; slightly hard, very friable; strongly acid; abrupt wavy boundary.

A2—7 to 9 inches; light gray (10YR 6/1) silt loam, gray (10YR 5/1) moist; few fine faint yellowish brown (10YR 6/6) mottles; moderate medium platy structure parting to weak fine granular; soft, very friable; slightly acid; abrupt wavy boundary.

B21t—9 to 13 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; light gray coating on faces of peds; many fine and medium faint yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, firm; many fine to coarse dark concretions (iron and manganese oxides); medium acid; clear wavy boundary.

B22t—13 to 25 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; few to common fine faint yellowish brown (10YR 5/6) mottles; strong coarse prismatic structure parting to strong medium angular blocky; very hard, very firm; shiny surfaces on peds; many fine to coarse dark concretions (iron and manganese oxides); slightly acid; gradual wavy boundary.

B23t—25 to 60 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; strong coarse prismatic structure parting to strong coarse angular blocky; very hard, very firm; shiny surfaces on faces of peds; many fine to coarse dark concretions (iron and manganese oxides); neutral; diffuse smooth boundary.

The thickness of the solum is generally 55 to 85 inches, but ranges from 50 to 90 inches. Most pedons do not have free carbonates, but if carbonates are present, they are at depths of more than 55 inches. Most pedons contain few to many, fine to coarse, and faint to prominent (hue of 10YR to 5YR) mottles.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is most commonly silty clay loam and, less commonly, silt loam, silty clay, or clay. The A2 horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 1. Some pedons contain iron-manganese concretions in the lower part. Reaction in the A and A2 horizons ranges from slightly acid to strongly acid. The B2t horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 or 5 (2 or 3 moist); and chroma of 1 or 2. It is silty clay loam, silty clay, or clay and averages from 40 to 55 percent clay. Reaction ranges from medium acid to neutral.

The C horizon, if present, has hue of 10YR, 2.5Y, or 5Y; value of 4 to 7 (4 to 6 moist); and chroma of 1 to 3. It is silt loam, silty clay loam, or silty clay. Reaction is neutral or mildly alkaline.

Meadin series

The Meadin series consists of excessively drained soils that are shallow over sand and gravel. Permeability is rapid. The soils formed in loamy and sandy material on uplands and foot slopes (fig. 23). Slope ranges from 3 to 30 percent.

Meadin soils are commonly adjacent to Cass, Geary, Hobbs, and Hord soils. All of these soils are deep. Cass soils are in the coarse-loamy family and are on bottom lands. Geary, Hobbs, and Hord soils are in the fine-silty family. Geary soils are on uplands, Hobbs soils are on bottom lands, and Hord soils are on terraces.

Typical profile of Meadin sandy loam, 3 to 30 percent slopes, 1,740 feet north and 740 feet east of the southwest corner of sec. 29, T. 5 N., R. 7 W.

A1—0 to 7 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable; medium acid; gradual wavy boundary.

AC—7 to 11 inches; brown (10YR 4/3) coarse sand, dark brown (10YR 3/3) moist; weak fine granular structure; loose, very friable; slightly acid; gradual wavy boundary.

IIC1—11 to 42 inches; very pale brown (10YR 7/4) gravelly coarse sand, light yellowish brown (10YR 6/4) moist; single grain; loose; about 35 percent by volume of gravel up to 1/2 inch in diameter; neutral; gradual wavy boundary.

IIC2—42 to 60 inches; very pale brown (10YR 7/3) very gravelly coarse sand, pale brown (10YR 6/3) moist; single grain; loose; about 55 percent by volume of gravel up to 1- 1/2 inches in diameter; neutral.

The thickness of the solum and the depth to sand and gravel range from 8 to 20 inches. The thickness of the mollic epipedon is more than 7 inches unless it is loamy sand, then it is more than 10 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is loam, sandy loam, or loamy sand with scattered gravel pebbles in most pedons. Reaction

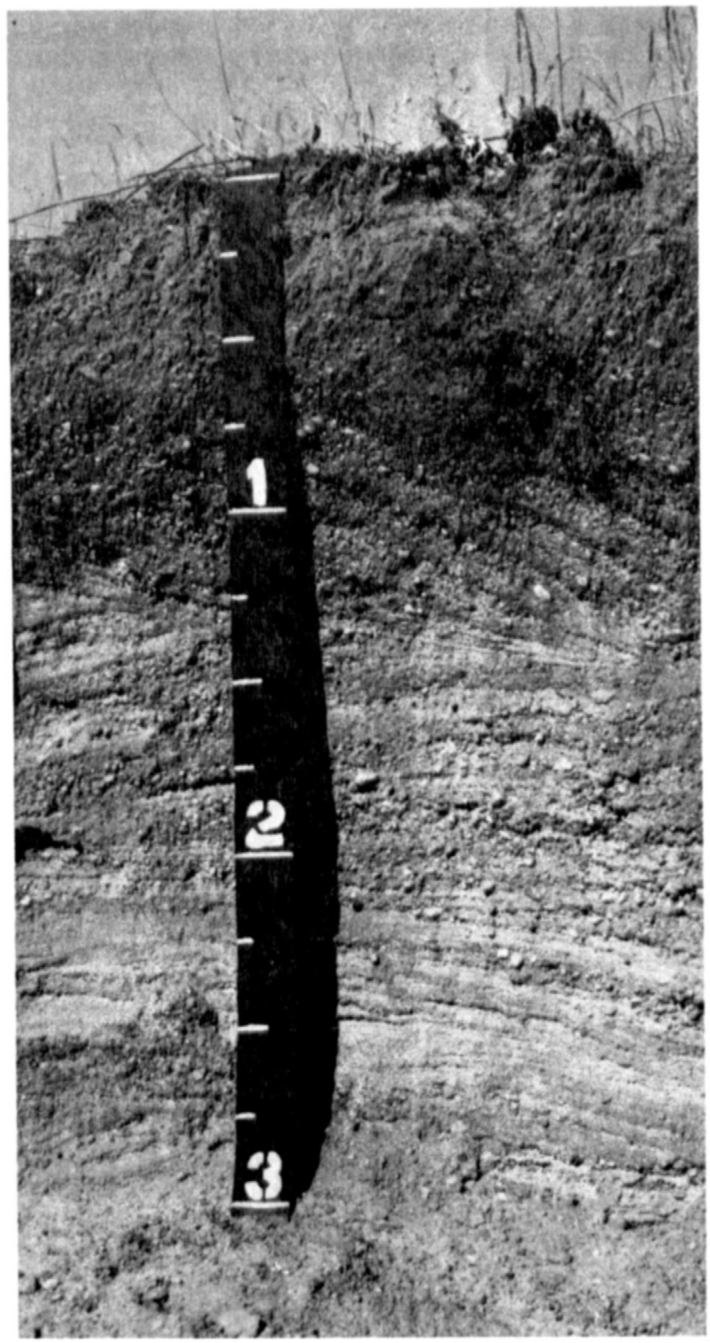

Figure 23.—Profile of Meadin sandy loam, 3 to 30 percent slopes. Gravelly coarse sand is at a depth of about 11 inches (scale in feet).

ranges from medium acid to neutral. The AC horizon is loamy sand or coarse sand. It contains 10 to 50 percent gravel by volume. The IIC horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. It contains 30 to 70 percent gravel by volume. It is stratified with finer, darker materials in some pedons. Reaction in the AC and IIC horizons is slightly acid or neutral.

Scott series

The Scott series consists of deep, very poorly drained soils in the lower parts of depressions or basins on uplands. Permeability is very slow. The soils formed in loess or loess that has been modified by water. Slope is less than 1 percent.

Scott soils are similar to Fillmore and Massie soils and are commonly adjacent to Butler, Crete, Fillmore, Hastings and Massie soils. Butler soils do not have an albic horizon and are in better drained, flat or concave positions higher on the landscape. Crete and Hastings soils do not have an A2 horizon and are not in depressions. Fillmore soils have thicker A1 and A2 horizons and are better drained. Massie soils have a solum that is thicker than that of the Scott soils. Also, they are ponded for longer periods, and the ponded water is deeper.

Typical pedon of Scott silt loam, 0 to 1 percent slopes, 650 feet east and 230 feet north of the southwest corner of sec. 4, T. 6 N., R. 6 W.

A1—0 to 5 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; soft, very friable; medium acid; abrupt smooth boundary.

A2—5 to 7 inches; light gray (10YR 6/1) silt loam, gray (10YR 5/1) moist; strong thick platy structure parting to weak fine granular; soft, very friable; medium acid; abrupt smooth boundary.

B21t—7 to 22 inches; gray (10YR 5/1) silty clay loam, black (10YR 2/1) moist; few to many fine and medium faint yellowish brown (10YR 5/8) mottles; strong coarse prismatic structure parting to strong fine angular blocky; very hard, very firm; shiny surfaces on most peds; common fine and medium dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

B22t—22 to 42 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; strong coarse prismatic structure parting to strong coarse angular blocky; very hard, very firm; shiny surfaces on most peds; common fine and medium dark concretions (iron and manganese oxides); neutral; gradual smooth boundary.

B3—42 to 55 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; hard, firm; neutral; clear smooth boundary.

C—55 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; few fine and medium yellowish red (5YR 4/8 and 5/8) mottles; massive; slightly hard, friable; neutral.

The thickness of the solum ranges from 35 to 56 inches, and the depth to free carbonates ranges from 45 to 60 inches or more.

The A1 horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. The A2 horizon has value of 5 through 7 (4 or 5 moist) and chroma of 1. Reaction in the A1 and A2 horizons is medium acid or slightly acid. The B2t horizon has hue of 10YR or 2.5Y, value of 3 through 5 (2 or 3 moist), and chroma of 1 or 2. It is silty clay loam or silty clay and averages from 38 to 55 percent clay. Reaction ranges from medium acid to neutral. In the B3 horizon, reaction is neutral or mildly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4. It is silt loam or silty clay loam. It has soft accumulations or concretions of carbonate in some pedons. Reaction is neutral or mildly alkaline. Mottles are in the lower part of the B3 and C horizons in some pedons.

Uly series

The Uly series consists of deep, somewhat excessively drained soils on uplands. Permeability is moderate. The soils formed in calcareous loess. Slope ranges from 3 to 30 percent.

Uly soils are commonly adjacent to Geary, Hastings, Hobbs, and Holder soils. Geary, Hastings, and Holder soils have an argillic horizon. Geary soils have redder hue in the subsoil. All of these soils are on more gentle slopes than Uly soils. Hobbs soils do not have a B horizon and formed in noncalcareous, silty alluvium on bottom lands.

Typical pedon of Uly silt loam from an area of Uly-Hobbs silt loams, 0 to 30 percent slopes, 2,380 feet north and 160 feet east of the southwest corner of sec. 33, T. 5 N., R. 8 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; neutral; gradual wavy boundary.

B1—8 to 10 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak medium and fine subangular blocky structure; slightly hard, friable; neutral; gradual wavy boundary.

B2—10 to 18 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; slightly hard, friable; neutral; gradual wavy boundary.

B3—18 to 23 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 5/3) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; slightly hard, friable; few soft accumulations of carbonate; strong effervescence (2 percent calcium carbonate); mildly alkaline; gradual wavy boundary.

C—23 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; soft, very friable; few soft accumulations of carbonate; strong effervescence (1 percent calcium carbonate); moderately alkaline.

The thickness of the solum ranges from 14 to 30 inches. Depth to free carbonates typically ranges from 8 to 25 inches, but the carbonates are deeper in some pedons. The thickness of the mollic epipedon ranges from 8 to 15 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2. The B horizon has value of 4 through 7 (3 through 5 moist) and chroma of 2 or 3. It is dominantly silt loam, but in some pedons it is silty clay loam. It averages from 18 to 29 percent clay. The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 3. Reaction is mildly alkaline or moderately alkaline.

In map unit UyE2, the surface layer is slightly lighter in color than the defined range for the series, but this difference does not alter the usefulness or behavior of the soils.

formation of the soils

This section describes how the factors of soil formation have affected the development of soils in Clay County.

factors of soil formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agents. The characteristics of the soil at any given point are determined by—(1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

parent material

The soils in Clay County formed in three kinds of parent material—loess, alluvium, and sand and gravel.

The most extensive parent material is Peorian loess. It is grayish brown, brown, and yellowish brown silt loam. Its thickness ranges from less than 1 foot to 30 feet and averages about 20 feet. Crete, Hall, Hastings, Holder, Hord, and Uly soils formed in Peorian loess. They are on upland areas of the county. Butler, Fillmore, Scott, and Massie soils also formed in Peorian loess, modified by water, and are in slightly concave areas, basins, and depressions on uplands.

Alluvium, which is the second most extensive parent material, consists of clay, silt, sand, or gravel that was washed from uplands and deposited on flood plains and stream terraces. This material is mixed in different proportions and is commonly deposited in layers. Its thickness ranges from a few feet in small upland drainageways to more than 30 feet in major river valleys. Cass, Hobbs, and Hord soils formed in alluvium.

Material from the Loveland Formation underlies the Peorian loess and is the third most extensive parent material in the county. This reddish to brownish material is commonly believed to be loessial in origin. It is older, more oxidized, and has slightly more sand than the Peorian loess. Its thickness ranges from 0 to 30 feet. It is exposed on the lower side slopes of the major drainageways. Large areas are along the Little Blue River, and smaller areas are along the West Fork of the Big Blue River and some of the creeks. Geary soils formed in loess of the Loveland Formation.

Sand and gravel of the Pleistocene age are the least extensive of the parent material in Clay County. They were deposited by water as a heterogenous mixture. They underlie the Loveland loess and are exposed in places along both sides of the Little Blue River and also along the Pawnee and Big Sandy Creeks. Meadin soils have sand and gravel in the underlying material.

climate

Climate has a direct and indirect influence on the formation of soils. It affects the weathering and reworking of soil material directly through rainfall, temperature, and wind and indirectly through the amount and kind of vegetation and animal life that can be sustained.

Precipitation falls on the surface, and some water moves through the soil. Nutrients, clay, and organic matter are carried by the water from the surface layer to the subsoil or underlying layers. Leaching is normally limited to the upper 3 or 4 feet in loess soils. The depth to calcium carbonate and the amount of clay in the subsoil have been modified by water movement in loess soils. The claypan soils in the depressions of Clay County are in the advanced stages of leaching and concentration of clay in the subsoil. In other areas, water flows through the drainageways where it removes, mixes, and redeposits unconsolidated material of all kinds. The alluvial soils in this county are examples of soils that formed in water deposited sediment.

Alternate freezing and thawing speed the mechanical weathering of parent material. Frost penetrates to a depth of 2 to 4 feet if moisture is sufficient. Chemical weathering is aided by summer heat and humidity.

Wind transfers soil material from one place to another. The extent of Peorian loess in this county indicates the importance of wind as an agent of deposition of soil material. Crete, Hastings, Holder, and Uly soils are examples of soils that formed in wind deposited material.

Climate affects the soils indirectly through the kind and amount of vegetative cover and animal life that can be sustained. The main source of organic matter in a soil is vegetation. Micro-organisms and animals that live in the soil help to decay dead plants. Burrowing animals and earthworms help in mixing the soil.

The climate of Clay County is characterized by the great seasonal extremes. The county has moderately long and cold winters with moderate snows and cool springs with appreciable precipitation. Summers are warm. Many thundershowers occur early in this season. Droughts are not uncommon late in summer. Autumns are moderately long and mild with occasional periods of rain.

The climate is fairly uniform throughout the county. Differences in the soils cannot be attributed to it. The temperature commonly drops below 0 degrees F. in winter and climbs to above 100 degrees F. in summer. The annual average precipitation is about 27.5 inches.

plant and animal life

The soils in Clay County formed mainly under tall, mid, and short native grasses. These grasses provide a plentiful supply of organic matter that improves the chemical and physical properties of the soil. The fibrous roots of these grasses penetrate the soil to a depth of several feet, making it more porous and more granular. Less runoff occurs and more moisture is available for increased microbiological activity. The decay of grass roots and leaves improves the available water capacity, tilth, and fertility of the soil. This decayed organic matter, acumulating over long periods, gives the surface layer its dark color.

Micro-organisms are important in soil formation because they feed on undecomposed organic matter and convert it into humus from which plants can obtain nutrients for increased growth. Bacteria and different kinds of fungi attack leaves and other forms of organic matter. Insects, earthworms, and small burrowing animals help to mix the humus with the soil.

Man greatly affects the plant and animal life of the soil. Through his management the soil can be conserved or lost by erosion, alive with micro-organisms or sterile without them, and fertile or unproductive. Man also can influence the kinds of plants grown. Some plants encourage the rate of soil formation more than others.

relief

The slope of the soils in Clay County ranges from nearly level to steep. The degree of slope and shape of the surface affect each soil that develops by influencing the amount of runoff and internal drainage.

Generally, as the degree of slope increases, the thickness of the soil profile decreases. For example, Uly silt loam that has slopes of 11 to 17 percent has a thinner soil profile and a lighter colored surface layer than Holder silt loam that has slopes of 6 to 11 percent. The steeper slopes have more runoff, resulting in less moisture available for plant growth and microbiological activity. Lime is normally not leached so deeply in soils that have steeper slopes. Erosion occurs more on steeper slopes if they are unprotected.

Nearly level and gently sloping soils generally have a thick surface layer and subsoil. More rainfall soaks into these soils than in the more sloping soils; therefore plant growth, microbiological activity, and the rate of soil formation are increased. For these reasons, the subsoil is thicker and has more clay in Hastings silt loam, 0 to 1 percent slopes, for example, than in Holder silt loam, 3 to 6 percent slopes.

Soils in depressions, such as Fillmore, Scott, and Massie silt loams, have no runoff and are poorly drained or very poorly drained. This additional moisture has advanced the concentration of clay in the subsoil of these soils.

Soils on the bottom lands are mostly nearly level, and they are occasionally or frequently flooded for brief periods. Each overflow deposits more soil material. Decay of organic matter and clay development are slower in this material than in well drained soils. Cass and Hobbs soils are bottom land soils.

time

The amount of time required for a soil to form mainly depends on the kind of parent material. The finer the texture of the parent material, the longer the time needed for soil formation. Finer textures retard the downward movement of water, which is necessary in the process of soil formation. Soils that formed in material from silt loam loess, such as Crete and Hastings soils, take longer to develop than soils that formed in sand and gravel, such as Meadin soils.

The youngest soils in Clay County formed in recently deposited alluvium. They have little or no subsoil development because of the brief time the parent material has been in place. The surface layer of these soils, however, has a dark color. The Cass and Hobbs soils are young. Hord soils are in the beginning stages of subsoil development. Most of the Hord soils formed in alluvium on stream terraces in Clay County.

The oldest and most extensive soils in the county are on uplands and have been in place long enough for fairly thick genetic horizons to develop. The texture of the subsoil is finer than that of the parent material. Holder, Hastings, Crete, and Butler soils are examples of soils that have a well developed subsoil.

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glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves all or part of the crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Organic matter content. The amount of organic matter in soil material. The classes used in this survey are low, 0.5 to 1.0 percent organic matter present; moderately low, 1.0 to 2.0 percent; moderate, 2.0 to 4.0 percent; and high, 4.0 to 8.0 percent.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The slope classes in this survey are as follows:

	Percent-ages
Nearly level	0 to 2
Very gently sloping	1 to 3
Gently sloping	3 to 6
Strongly sloping	6 to 11
Moderately steep	11 to 17
Steep	11 to 30

Slow intake (in tables). The slow movement of water into the soil.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-73 at Clay Center, Nebraska]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	34.2	11.5	22.9	63	-16	0	.58	.21	.87	2	6.9
February---	41.6	17.5	29.5	73	-10	8	.91	.25	1.42	3	6.4
March------	50.9	25.3	38.1	83	0	44	1.65	.46	2.60	4	6.5
April------	64.7	37.4	51.0	91	17	122	2.44	1.29	3.38	6	1.7
May--------	74.8	49.1	62.0	95	29	381	4.34	2.09	6.29	7	.2
June-------	84.7	59.4	72.1	103	41	663	4.31	2.34	5.92	7	.0
July-------	89.6	64.0	76.8	104	50	831	3.85	1.91	5.44	6	.0
August-----	88.5	62.5	75.5	103	48	791	3.09	1.29	4.55	5	.0
September--	78.9	52.7	65.8	100	33	474	3.26	1.31	4.84	6	.0
October----	69.4	40.6	55.0	91	21	217	1.43	.33	2.30	3	.2
November---	51.5	26.9	39.2	76	5	8	.85	.12	1.39	2	3.0
December---	38.7	16.9	27.8	67	-12	0	.77	.23	1.20	2	8.6
Yearly:											
Average--	64.0	38.7	51.3	---	---	---	---	---	---	---	---
Extreme--	---	---	---	105	-16	---	---	---	---	---	---
Total----	---	---	---	---	---	3,539	27.48	21.10	32.79	53	33.5

[1] A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-73 at Clay Center, Nebraska]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 22	May 5	May 13
2 years in 10 later than--	April 17	April 29	May 8
5 years in 10 later than--	April 9	April 19	April 28
First freezing temperature in fall:			
1 year in 10 earlier than--	October 20	October 10	September 30
2 years in 10 earlier than--	October 25	October 14	October 4
5 years in 10 earlier than--	November 2	October 22	October 13

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-73 at Clay Center, Nebraska]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	188	168	148
8 years in 10	194	174	155
5 years in 10	206	185	167
2 years in 10	218	197	180
1 year in 10	224	203	187

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Bu	Butler silt loam, 0 to 1 percent slopes	26,000	7.1
Ca	Cass fine sandy loam, overwash, 0 to 2 percent slopes	450	0.1
Cd	Cass silt loam, 0 to 1 percent slopes	1,325	0.4
Ce	Crete silt loam, 0 to 1 percent slopes	71,800	19.6
CeB	Crete silt loam, 1 to 3 percent slopes	8,150	2.2
Cg	Crete silt loam, thick solum, 0 to 1 percent slopes	13,370	3.7
Fm	Fillmore silt loam, 0 to 1 percent slopes	9,050	2.5
Fo	Fillmore silt loam, drained, 0 to 1 percent slopes	4,250	1.2
GaC	Geary silt loam, 3 to 6 percent slopes	230	0.1
GaD	Geary silt loam, 6 to 11 percent slopes	520	0.1
GaF	Geary-Hobbs silt loams, 0 to 30 percent slopes	3,100	0.8
GeC2	Geary silty clay loam, 3 to 6 percent slopes, eroded	230	0.1
GeD2	Geary silty clay loam, 6 to 11 percent slopes, eroded	1,950	0.5
GeE2	Geary silty clay loam, 11 to 17 percent slopes, eroded	490	0.1
Ha	Hall silt loam, 0 to 1 percent slopes	3,500	1.0
Hc	Hastings silt loam, 0 to 1 percent slopes	79,700	21.7
HcB	Hastings silt loam, 1 to 3 percent slopes	53,730	14.6
HcC	Hastings silt loam, 3 to 6 percent slopes	2,800	0.8
HdC2	Hastings silty clay loam, 3 to 6 percent slopes, eroded	21,550	5.9
HdD2	Hastings silty clay loam, 6 to 11 percent slopes, eroded	3,710	1.0
He	Hobbs silt loam, 0 to 2 percent slopes	4,475	1.2
Hf	Hobbs silt loam, channeled	6,820	1.9
HgC	Holder silt loam, 3 to 6 percent slopes	3,175	0.9
HgD	Holder silt loam, 6 to 11 percent slopes	915	0.3
HhC2	Holder silty clay loam, 3 to 6 percent slopes, eroded	4,925	1.4
HhD2	Holder silty clay loam, 6 to 11 percent slopes, eroded	10,800	3.0
Hr	Hord silt loam, 0 to 1 percent slopes	5,720	1.6
HrB	Hord silt loam, 1 to 3 percent slopes	3,500	1.0
Ma	Massie silty clay loam, 0 to 1 percent slopes	2,930	0.8
MdF	Meadin sandy loam, 3 to 30 percent slopes	700	0.2
Pt	Pits, Gravel	130	*
Sc	Scott silt loam, 0 to 1 percent slopes	4,700	1.3
UyE2	Uly silt loam, 11 to 17 percent slopes, eroded	1,300	0.4
UyF	Uly-Hobbs silt loams, 0 to 30 percent slopes	6,065	1.7
	Water	2,740	0.8
	Total	364,800	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn		Grain sorghum		Winter wheat	Alfalfa hay	
	N	I	N	I	N	N	I
	Bu	Bu	Bu	Bu	Bu	Ton	Ton
Bu Butler	48	135	67	110	40	3.2	5.5
Ca Cass	48	130	58	105	32	3.0	6.0
Cd Cass	50	140	65	115	38	3.5	6.5
Ce Crete	50	140	68	112	43	3.5	6.0
CeB Crete	47	135	65	105	38	3.2	5.5
Cg Crete	54	143	70	114	44	3.5	6.3
Fm Fillmore	30	---	45	---	---	---	---
Fo Fillmore	48	135	67	110	40	3.1	5.4
GaC Geary	47	130	61	105	36	2.9	5.8
GaD Geary	41	---	50	---	29	2.4	4.9
GaF Geary-Hobbs	---	---	---	---	---	---	---
GeC2 Geary	42	120	57	95	34	2.5	5.3
GeD2 Geary	32	---	42	---	26	2.1	4.5
GeE2 Geary	---	---	---	---	---	---	---
Ha Hall	62	145	72	115	45	3.8	6.5
Hc Hastings	58	145	72	115	45	3.8	6.5
HcB Hastings	55	140	69	110	43	3.6	6.2
HcC Hastings	47	130	61	105	36	2.9	5.8
HdC2 Hastings	42	120	57	95	34	2.5	5.3
HdD2 Hastings	32	---	36	---	26	2.1	4.5
He Hobbs	55	135	69	110	34	3.8	6.5
Hf Hobbs	---	---	---	---	---	---	---

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Grain sorghum		Winter wheat	Alfalfa hay	
	N	I	N	I	N	N	I
	Bu	Bu	Bu	Bu	Bu	Ton	Ton
HgC Holder	49	130	64	105	38	3.0	5.8
HgD Holder	42	---	52	---	30	2.5	5.0
HhC2 Holder	44	120	58	95	35	2.6	5.4
HhD2 Holder	34	---	45	---	27	2.2	4.6
Hr Hord	60	145	80	115	40	3.8	6.5
HrB Hord	55	140	75	110	37	3.6	6.2
Ma Massie	---	---	---	---	---	---	---
MdF Meadin	---	---	---	---	---	---	---
Pt*. Pits							
Sc Scott	---	---	30	---	---	---	---
UyE2 Uly	---	---	---	---	---	---	---
UyF Uly-Hobbs	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only those potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Dashes indicate no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I (N)	88,920	---	---	---
(I)	88,920	---	---	---
II (N)	187,050	65,380	36,050	85,620
(I)	187,050	65,380	36,050	85,620
III (N)	41,960	32,910	9,050	---
(I)	41,960	32,910	9,050	---
IV (N)	22,595	17,895	4,700	---
(I)	17,895	17,895	---	---
V (N)	---	---	---	---
VI (N)	18,475	10,955	6,820	700
VII (N)	---	---	---	---
VIII(N)	3,060	---	3,060	---

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation are listed]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Bu: Butler	Clayey	Favorable	4,000	Little bluestem	25
		Normal	2,800	Big bluestem	20
		Unfavorable	1,500	Switchgrass	15
				Tall dropseed	5
				Sedge	5
Ca, Cd: Cass	Sandy Lowland	Favorable	4,000	Sand bluestem	30
		Normal	3,500	Little bluestem	15
		Unfavorable	2,500	Switchgrass	15
				Indiangrass	10
				Porcupinegrass	10
				Kentucky bluegrass	5
				Sedge	5
Ce, CeB, Cg: Crete	Clayey	Favorable	3,500	Big bluestem	25
		Normal	2,800	Little bluestem	15
		Unfavorable	1,500	Switchgrass	10
				Sideoats grama	10
				Indiangrass	5
				Western wheatgrass	5
				Tall dropseed	5
				Sedge	5
				Blue grama	5
				Porcupinegrass	5
Fm: Fillmore	Clayey Overflow	Favorable	4,000	Big bluestem	20
		Normal	3,000	Western wheatgrass	20
		Unfavorable	1,500	Switchgrass	15
				Little bluestem	10
				Blue grama	10
				Indiangrass	5
				Canada wildrye	5
				Buffalograss	5
				Sedge	5
				Kentucky bluegrass	5
Fo: Fillmore	Clayey	Favorable	4,000	Big bluestem	20
		Normal	2,800	Little bluestem	25
		Unfavorable	1,500	Switchgrass	15
				Tall dropseed	5
				Sedge	5
GaC, GaD: Geary	Silty	Favorable	3,250	Big bluestem	35
		Normal	2,500	Little bluestem	20
		Unfavorable	1,750	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Blue grama	5
GaF*:					
Geary	Silty	Favorable	3,000	Big bluestem	35
		Normal	2,250	Little bluestem	20
		Unfavorable	1,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Blue grama	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
GaF*:					
Hobbs	Silty Overflow	Favorable	5,000	Big bluestem	30
		Normal	4,500	Western wheatgrass	12
		Unfavorable	3,500	Switchgrass	10
				Indiangrass	7
				Little bluestem	6
				Sideoats grama	5
				Tall dropseed	5
				Maximilian sunflower	5
				Wholeleaf rosinweed	5
				Sedge	5
				Blue grama	5
GeC2, GeD2, GeE2 Geary	Silty	Favorable	3,250	Big bluestem	35
		Normal	2,500	Little bluestem	20
		Unfavorable	1,750	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Blue grama	5
Ha Hall	Silty	Favorable	4,000	Little bluestem	20
		Normal	3,250	Big bluestem	15
		Unfavorable	2,000	Western wheatgrass	15
				Switchgrass	10
				Sideoats grama	7
				Indiangrass	5
				Sedge	5
				Blue grama	5
				Needleandthread	5
Hc, HcB, HcC, HdC2, HdD2 Hastings	Silty	Favorable	3,500	Big bluestem	25
		Normal	2,750	Little bluestem	20
		Unfavorable	1,750	Sideoats grama	15
				Blue grama	10
				Western wheatgrass	10
				Switchgrass	5
				Buffalograss	5
He, Hf Hobbs	Silty Overflow	Favorable	5,000	Big bluestem	30
		Normal	4,250	Western wheatgrass	12
		Unfavorable	3,500	Switchgrass	10
				Indiangrass	7
				Little bluestem	6
				Sideoats grama	5
				Tall dropseed	5
				Maximilian sunflower	5
				Wholeleaf rosinweed	5
				Sedge	5
				Blue grama	5
HgC, HgD, HhC2, HhD2 Holder	Silty	Favorable	3,750	Big bluestem	22
		Normal	3,000	Little bluestem	18
		Unfavorable	2,000	Sideoats grama	15
				Blue grama	10
				Western wheatgrass	10
				Buffalograss	5
				Sand dropseed	5
				Sedge	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Hr, HrB: Hord	Silty Lowland	Favorable	4,500	Big bluestem	30
		Normal	3,500	Little bluestem	10
		Unfavorable	2,250	Indiangrass	10
				Switchgrass	10
				Porcupinegrass	8
				Sideoats grama	5
				Tall dropseed	5
				Western wheatgrass	5
				Sedge	5
MdF: Meadin	Shallow To Gravel	Favorable	2,300	Blue grama	20
		Normal	1,700	Prairie sandreed	10
		Unfavorable	1,000	Sand bluestem	10
				Sand dropseed	10
				Needleandthread	10
				Clubmoss	10
				Little bluestem	5
				Switchgrass	5
				Purple lovegrass	5
				Sedge	5
UyE2: Uly	Silty	Favorable	3,000	Big bluestem	35
		Normal	2,250	Little bluestem	25
		Unfavorable	1,500	Western wheatgrass	12
				Blue grama	6
				Sedge	5
UyF*:					
Uly	Silty	Favorable	2,750	Big bluestem	35
		Normal	2,000	Little bluestem	25
		Unfavorable	1,500	Western wheatgrass	12
				Blue grama	6
				Sedge	5
Hobbs	Silty Overflow	Favorable	5,000	Big bluestem	30
		Normal	4,250	Western wheatgrass	12
		Unfavorable	3,500	Switchgrass	10
				Indiangrass	7
				Little bluestem	6
				Sideoats grama	5
				Tall dropseed	5
				Maximilian sunflower	5
				Wholeleaf rosinweed	5
				Sedge	5
				Blue grama	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
Bu-- Butler	Redosier dogwood, American plum.	Common chokecherry	Eastern redcedar, Russian mulberry, Austrian pine, common hackberry.	Honeylocust, green ash, silver maple, golden willow.	Eastern cottonwood.
Ca, Cd-- Cass	Peking cotoneaster, lilac, American plum.	Common chokecherry, autumn-olive.	Eastern redcedar, Russian mulberry, honeylocust, green ash.	Austrian pine, Scotch pine, ponderosa pine.	---
Ce, CeB, Cg-- Crete	Peking cotoneaster, Amur honeysuckle, skunkbush sumac.	Common chokecherry	Ponderosa pine, eastern redcedar, green ash, common hackberry, honeylocust, Russian mulberry, Austrian pine, bur oak.	---	---
Fm-- Fillmore	Redosier dogwood	Common chokecherry	Eastern redcedar, green ash, golden willow, honeylocust, common hackberry.	Silver maple--	Eastern cottonwood.
Fo-- Fillmore	Redosier dogwood, American plum.	Common chokecherry	Eastern redcedar, Russian mulberry, Austrian pine, common hackberry.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
GaC, GaD-- Geary	Skunkbush sumac, Peking cotoneaster, Amur honeysuckle.	Common chokecherry	Eastern redcedar, common hackberry, osageorange, green ash, ponderosa pine, Austrian pine.	Honeylocust--	Siberian elm.
GaF*:					
Geary--	---	---	---	---	---
Hobbs--	American plum, lilac.	Amur honeysuckle--	Eastern redcedar, Russian mulberry, green ash, Russian-olive.	Ponderosa pine, Austrian pine, honeylocust, common hackberry.	Eastern cottonwood.
GeC2, GeD2, GeE2-- Geary	Skunkbush sumac, Peking cotoneaster, Amur honeysuckle.	Common chokecherry	Eastern redcedar, common hackberry, osageorange, green ash, ponderosa pine, Austrian pine.	Honeylocust--	Siberian elm.
Ha-- Hall	Peking cotoneaster, Amur honeysuckle, skunkbush sumac.	Common chokecherry	Eastern redcedar, green ash, common hackberry, ponderosa pine, Russian mulberry, bur oak.	Honeylocust--	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Hc, HcB, HcC, HdC2, HdD2: Hastings	Amur honeysuckle, skunkbush sumac, Peking cotoneaster.	Common chokecherry	Russian mulberry, Eastern redcedar, green ash, common hackberry, ponderosa pine, bur oak.	Honeylocust	---
He: Hobbs	American plum, lilac.	Amur honeysuckle	Eastern redcedar, Russian mulberry, green ash, Russian-olive.	Ponderosa pine, Austrian pine, honeylocust, common hackberry.	Eastern cottonwood.
Hf. Hobbs	---	---	---	---	---
HgC, HgD, HhC2, HhD2: Holder	Amur honeysuckle, skunkbush sumac, Peking cotoneaster.	Autumn-olive, Amur honeysuckle, Peking cotoneaster, American plum.	Eastern redcedar, common hackberry, bur oak.	Austrian pine, ponderosa pine, Scotch pine, green ash, honeylocust.	---
Hr, HrB: Hord	Peking cotoneaster, Amur honeysuckle, skunkbush sumac.	Common chokecherry	Eastern redcedar, green ash, common hackberry, bur oak.	Ponderosa pine, Austrian pine, honeylocust.	Eastern cottonwood.
Ma. Massie	---	---	---	---	---
MdF. Meadin	---	---	---	---	---
Pt*. Pits					
Sc. Scott	---	---	---	---	---
UyE2: Uly	Amur honeysuckle, skunkbush sumac, lilac.	Common chokecherry	Eastern redcedar, green ash, Russian-olive, honeylocust, ponderosa pine, Austrian pine, bur oak.	Siberian elm	---
UyF*: Uly.	---	---	---	---	---
Hobbs	American plum, lilac.	Amur honeysuckle	Eastern redcedar, Russian mulberry, green ash, Russian-olive.	Ponderosa pine, Austrian pine, honeylocust, common hackberry.	Eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Bu-------- Butler	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, erodes easily.	Severe: wetness.
Ca, Cd-------- Cass	Severe: floods.	Slight----------	Moderate: floods.	Slight----------	Moderate: floods.
Ce-------- Crete	Slight----------	Slight----------	Slight----------	Severe: erodes easily.	Slight.
CeB-------- Crete	Slight----------	Slight----------	Moderate: slope.	Severe: erodes easily.	Slight.
Cg-------- Crete	Slight----------	Slight----------	Slight----------	Severe: erodes easily.	Slight.
Fm-------- Fillmore	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
Fo-------- Fillmore	Severe: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight----------	Moderate: wetness.
GaC-------- Geary	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
GaD-------- Geary	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
GaF*:					
Geary--------	Severe: slope.	Severe: slope.	Severe: slope.	Slight----------	Severe: slope.
Hobbs--------	Severe: floods.	Slight----------	Moderate: floods.	Slight----------	Moderate: floods.
GeC2-------- Geary	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
GeD2, GeE2-------- Geary	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
Ha-------- Hall	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
Hc-------- Hastings	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
HcB, HcC, HdC2-------- Hastings	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
HdD2-------- Hastings	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
He-------- Hobbs	Severe: floods.	Slight----------	Moderate: floods.	Slight----------	Moderate: floods.
Hf-------- Hobbs	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
HgC-------- Holder	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
HgD------------------- Holder	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
HhC2------------------ Holder	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
HhD2------------------ Holder	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
Hr-------------------- Hord	Severe: floods.	Slight----------	Slight----------	Slight----------	Slight.
HrB------------------- Hord	Severe: floods.	Slight----------	Moderate: slope.	Slight----------	Slight.
Ma-------------------- Massie	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
MdF------------------- Meadin	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Pt*. Pits					
Sc-------------------- Scott	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, erodes easily.	Severe: ponding.
UyE2------------------ Uly	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
UyF*:					
Uly-------------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Hobbs-----------------	Severe: floods.	Slight----------	Moderate: floods.	Slight----------	Moderate: floods.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Bu------------------ Butler	Good	Good	Good	Fair	Good	Good	Fair	Fair	Good	Fair	Fair	Good.
Ca, Cd-------------- Cass	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ce, CeB, Cg--------- Crete	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Fm------------------ Fillmore	Fair	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Good	Fair.
Fo------------------ Fillmore	Good	Good	Good	Fair	Good	Good	Fair	Poor	Good	Good	Fair	Good.
GaC, GaD------------ Geary	Fair	Good	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
GaF*:												
Geary---------------	Poor	Poor	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
Hobbs---------------	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
GeC2, GeD2---------- Geary	Fair	Good	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
GeE2---------------- Geary	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Ha------------------ Hall	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Hc, HcB------------- Hastings	Good	Good	Good	Good	Good	Good	Very poor.	Poor	Good	Good	Very poor.	Good.
HcC, HdC2, HdD2----- Hastings	Fair	Good	Good	Good	Fair	Good	Very poor.	Poor	Good	Good	Very poor.	Good.
He------------------ Hobbs	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Hf------------------ Hobbs	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
HgC, HgD, HhC2, HhD2--------------- Holder	Fair	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Hr, HrB------------- Hord	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ma------------------ Massie	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
MdF----------------- Meadin	Very poor.	Poor	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Pt*. Pits												
Sc------------------ Scott	Poor	Fair	Fair	---	Poor	Poor	Good	Good	Fair	---	Good	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
UyE2----------------- Uly	Poor	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
UyF*:												
Uly-----------------	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Hobbs---------------	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Bu: Butler	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
Ca, Cd: Cass	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Ce, CeB, Cg: Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Fm: Fillmore	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, low strength, frost action.	Severe: ponding.
Fo: Fillmore	Moderate: too clayey.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Moderate: wetness.
GaC: Geary	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
GaD: Geary	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
GaF*:						
Geary	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength.	Severe: slope.
Hobbs	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Moderate: floods.
GeC2: Geary	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
GeD2, GeE2: Geary	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Ha: Hall	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Hc, HcB, HcC, HdC2: Hastings	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
HdD2: Hastings	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
He: Hobbs	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Moderate: floods.
Hf: Hobbs	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Severe: floods.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
HgC: Holder	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
HgD: Holder	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
HhC2: Holder	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
HhD2: Holder	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
Hr, HrB: Hord	Slight	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength.	Slight.
Ma: Massie	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
MdF: Meadin	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pt*. Pits						
Sc: Scott	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
UyE2: Uly	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
UyF*: Uly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Hobbs	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Moderate: floods.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Bu----------------- Butler	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
Ca, Cd------------- Cass	Severe: floods, poor filter.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Fair: thin layer.
Ce----------------- Crete	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight-----------	Poor: hard to pack, too clayey.
CeB---------------- Crete	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Poor: hard to pack, too clayey.
Cg----------------- Crete	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight-----------	Poor: hard to pack, too clayey.
Fm----------------- Fillmore	Severe: percs slowly, ponding.	Severe: ponding.	Severe: too clayey, ponding.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Fo----------------- Fillmore	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
GaC---------------- Geary	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
GaD---------------- Geary	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
GaF*:					
Geary--------------	Severe: percs slowly.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hobbs--------------	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
GeC2--------------- Geary	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
GeD2, GeE2--------- Geary	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Ha----------------- Hall	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Fair: too clayey.
Hc----------------- Hastings	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
HcB, HcC, HdC2----- Hastings	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
HdD2--------------- Hastings	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
He, Hf: Hobbs	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
HgC: Holder	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
HgD: Holder	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
HhC2: Holder	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
HhD2: Holder	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
Hr, HrB: Hord	Moderate: floods.	Severe: floods.	Moderate: floods.	Moderate: floods.	Good.
Ma: Massie	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
MdF: Meadin	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Pt*. Pits					
Sc: Scott	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
UyE2: Uly	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
UyF*:					
Uly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Hobbs	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Bu-------------------- Butler	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Ca, Cd---------------- Cass	Good-----------------	Probable-------------	Improbable: too sandy.	Good.
Ce, CeB, Cg----------- Crete	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Fm, Fo---------------- Fillmore	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, thin layer.
GaC------------------- Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
GaD------------------- Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
GaF*:				
Geary-----------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Hobbs-----------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
GeC2------------------ Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
GeD2, GeE2------------ Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Ha-------------------- Hall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Hc, HcB, HcC, HdC2, HdD2----------------- Hastings	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
He, Hf---------------- Hobbs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
HgC------------------- Holder	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
HgD------------------- Holder	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
HhC2------------------ Holder	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
HhD2------------------ Holder	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
Hr, HrB--------------- Hord	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ma: Massie	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
MdF: Meadin	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Pt*. Pits				
Sc: Scott	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
UyE2: Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
UyF*:				
Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Hobbs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Bu----------------- Butler	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
Ca----------------- Cass	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, floods.	Soil blowing---	Favorable.
Cd----------------- Cass	Severe: seepage.	Severe: piping.	Deep to water	Floods---------	Favorable------	Favorable.
Ce, CeB, Cg------- Crete	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Fm----------------- Fillmore	Moderate: seepage.	Severe: hard to pack, ponding.	Percs slowly, frost action, ponding.	Percs slowly, ponding, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
Fo----------------- Fillmore	Moderate: seepage.	Severe: hard to pack, wetness.	Percs slowly, frost action.	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Wetness, erodes easily, percs slowly.
GaC---------------- Geary	Moderate: seepage, slope.	Slight---------	Deep to water	Slope----------	Erodes easily	Erodes easily.
GaD---------------- Geary	Severe: slope.	Slight---------	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
GaF*:						
Geary------------	Severe: slope.	Slight---------	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Hobbs------------	Moderate: seepage.	Severe: piping.	Deep to water	Floods---------	Favorable------	Favorable.
GeC2--------------- Geary	Moderate: seepage, slope.	Slight---------	Deep to water	Slope----------	Erodes easily	Erodes easily.
GeD2, GeE2--------- Geary	Severe: slope.	Slight---------	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Ha----------------- Hall	Moderate: seepage.	Moderate: thin layer.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Hc, HcB------------ Hastings	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Favorable------	Erodes easily	Erodes easily.
HcC, HdC2---------- Hastings	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope----------	Erodes easily	Erodes easily.
HdD2--------------- Hastings	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
He, Hf------------- Hobbs	Moderate: seepage.	Severe: piping.	Deep to water	Floods---------	Favorable------	Favorable.
HgC---------------- Holder	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
HgD---------------- Holder	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily, slope.	Slope, erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
HhC2: Holder	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
HhD2: Holder	Severe: slope.	Severe: piping.	Deep to water	Slope	Erodes easily, slope.	Slope, erodes easily.
Hr, HrB: Hord	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
Ma: Massie	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, percs slowly.
MdF: Meadin	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
Pt*. Pits						
Sc: Scott	Moderate: seepage.	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
UyE2: Uly	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
UyF*: Uly	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Hobbs	Moderate: seepage.	Severe: piping.	Deep to water	Floods	Favorable	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Bu---------------- Butler	0-11	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	20-40	5-15
	11-31	Clay, silty clay	CH	A-7	0	100	100	100	95-100	50-70	30-45
	31-38	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	100	95-100	35-60	15-35
	38-60	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-60	10-35
Ca---------------- Cass	0-10	Fine sandy loam	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-40	<20	NP-5
	10-26	Fine sandy loam, sandy loam, very fine sandy loam.	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-50	<20	NP-5
	26-60	Loamy fine sand, fine sand, coarse sand.	SM, SP-SM	A-2, A-3	0	95-100	95-100	50-75	5-30	---	NP
Cd---------------- Cass	0-17	Silt loam, loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	60-75	25-40	5-15
	17-29	Fine sandy loam, sandy loam, very fine sandy loam.	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-50	<20	NP-5
	29-60	Loamy fine sand, fine sand, coarse sand.	SM, SP-SM	A-2, A-3	0	95-100	95-100	50-75	5-30	---	NP
Ce, CeB, Cg------ Crete	0-10	Silt loam--------	CL	A-4, A-6	0	100	100	100	95-100	30-40	8-15
	10-28	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-65	25-38
	28-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	15-35
Fm, Fo----------- Fillmore	0-13	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-40	2-20
	13-32	Silty clay, clay	CH	A-7	0	100	100	100	95-100	45-75	20-45
	32-44	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-60	20-40
	44-60	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	25-75	10-45
GaC, GaD--------- Geary	0-9	Silt loam--------	ML, CL	A-4, A-6, A-7	0	100	100	96-100	80-98	25-45	2-20
	9-40	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	40-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-22
GaF*:											
Geary-----------	0-9	Silt loam--------	ML, CL	A-4, A-6, A-7	0	100	100	96-100	80-98	25-45	2-20
	9-40	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	40-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-22
Hobbs-----------	0-7	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	7-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	80-100	25-40	5-20
GeC2, GeD2, GeE2- Geary	0-7	Silty clay loam	ML, CL	A-4, A-6, A-7	0	100	100	96-100	80-98	25-45	2-20
	7-31	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	31-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-22

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ha----------------- Hall	0-13	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-20
	13-36	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	15-30
	36-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	95-100	90-100	25-40	10-20
Hc, HcB, HcC------ Hastings	0-10	Silt loam--------	CL	A-6, A-4	0	100	100	100	95-100	28-40	8-18
	10-38	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	42-60	22-40
	38-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	30-45	11-25
HdC2, HdD2-------- Hastings	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	30-45	11-22
	7-23	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	42-60	22-40
	23-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	30-45	11-25
He, Hf------------ Hobbs	0-7	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	7-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	80-100	25-40	5-20
HgC, HgD---------- Holder	0-14	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	98-100	90-100	20-40	2-16
	14-26	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	95-100	35-50	20-35
	26-60	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	95-100	90-100	30-45	5-20
HhC2, HhD2-------- Holder	0-7	Silty clay loam	CL	A-7, A-6	0	100	100	98-100	95-100	35-50	20-35
	7-17	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	95-100	35-50	20-35
	17-60	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	95-100	90-100	30-45	5-20
Hr, HrB----------- Hord	0-16	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	3-18
	16-48	Silt loam, silty clay loam.	CL	A-6, A-4	0	100	100	98-100	85-100	25-40	8-23
	48-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	100	85-100	25-40	6-21
Ma----------------- Massie	0-9	Silty clay loam	CL	A-4, A-6, A-7	0	100	100	100	95-100	22-45	8-25
	9-60	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	100	100	100	95-100	45-70	20-45
MdF--------------- Meadin	0-7	Sandy loam-------	SM, ML, CL-ML, SM-SC	A-2, A-4	0	95-100	93-100	60-80	30-55	<20	NP-5
	7-60	Gravelly coarse sand, very gravelly coarse sand, coarse sand.	SP-SM, SP, GP-GM, GP	A-1	0	30-80	18-60	9-35	1-8	---	NP
Pt*. Pits											
Sc----------------- Scott	0-7	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	100	95-100	20-45	2-20
	7-42	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	100	95-100	45-75	20-45
	42-55	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-60	20-40
	55-60	Silt loam, silty clay loam, clay loam.	CL	A-4, A-6, A-7	0	100	100	90-100	90-100	25-50	8-24

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
UyE2-------------	0-5	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
Uly	5-14	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	14-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	7-15
UyF*:											
Uly-------------	0-8	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	8-23	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	23-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	7-15
Hobbs-----------	0-7	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	7-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	80-100	25-40	5-20

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH	Mmhos/cm					Pct
Bu--------------- Butler	0-11	18-35	1.20-1.40	0.6-2.0	0.20-0.22	5.1-7.3	<2	Moderate	0.37	4	6	2-4
	11-31	45-55	1.10-1.20	0.06-0.2	0.11-0.13	5.6-8.4	<2	High------	0.37			
	31-38	32-45	1.10-1.30	0.2-0.6	0.14-0.20	6.6-8.4	<2	High------	0.37			
	38-60	20-35	1.20-1.40	0.6-2.0	0.18-0.22	6.6-8.4	<2	Moderate	0.37			
Ca--------------- Cass	0-10	7-17	1.40-1.60	2.0-6.0	0.16-0.18	5.6-7.3	<2	Low-------	0.20	5	3	1-2
	10-26	5-15	1.40-1.60	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low-------	0.20			
	26-60	2-10	1.50-1.70	6.0-20	0.08-0.10	6.1-8.4	<2	Low-------	0.20			
Cd--------------- Cass	0-17	10-20	1.20-1.40	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low-------	0.28	5	5	1-2
	17-29	5-15	1.40-1.60	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low-------	0.20			
	29-60	2-10	1.50-1.70	6.0-20	0.08-0.10	6.1-8.4	<2	Low-------	0.20			
Ce, CeB, Cg------ Crete	0-10	20-27	1.20-1.40	0.6-2.0	0.22-0.24	5.6-6.0	<2	Moderate	0.37	4	6	2-4
	10-28	42-52	1.10-1.30	0.06-0.6	0.12-0.20	6.1-7.3	<2	High------	0.37			
	28-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-7.8	<2	High------	0.37			
Fm, Fo----------- Fillmore	0-13	18-35	1.30-1.40	0.6-2.0	0.21-0.24	5.6-6.5	<2	Moderate	0.37	4	6	3-4
	13-32	45-55	1.30-1.50	<0.06	0.11-0.20	5.6-7.8	<2	High------	0.37			
	32-44	32-40	1.10-1.40	0.2-0.6	0.18-0.20	6.6-7.8	<2	High------	0.37			
	44-60	18-45	1.30-1.50	0.6-2.0	0.10-0.22	6.6-8.4	<2	Moderate	0.37			
GaC, GaD--------- Geary	0-9	15-32	1.30-1.40	0.6-2.0	0.18-0.24	5.6-6.5	<2	Low-------	0.32	5	6	2-4
	9-40	27-35	1.35-1.50	0.2-0.6	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	40-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
GaF*:												
Geary-----------	0-9	15-32	1.30-1.40	0.6-2.0	0.18-0.24	5.6-6.5	<2	Low-------	0.32	5	6	1-2
	9-40	27-35	1.35-1.50	0.2-0.6	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	40-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
Hobbs-----------	0-7	18-27	1.10-1.30	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low-------	0.32	5	6	2-4
	7-60	18-30	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low-------	0.32			
GeC2, GeD2, GeE2- Geary	0-7	15-32	1.30-1.40	0.6-2.0	0.18-0.24	5.6-6.5	<2	Low-------	0.32	5	6	.5-1
	7-31	27-35	1.35-1.50	0.2-0.6	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	31-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
Ha--------------- Hall	0-13	20-27	1.30-1.40	0.6-2.0	0.20-0.24	6.1-7.3	<2	Moderate	0.32	5	6	2-4
	13-36	28-35	1.30-1.50	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.43			
	36-60	15-30	1.30-1.40	0.6-2.0	0.18-0.22	6.6-7.8	<2	Moderate	0.43			
Hc, HcB, HcC----- Hastings	0-10	18-25	1.20-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Moderate	0.32	5	6	2-4
	10-38	35-42	1.30-1.40	0.2-0.6	0.11-0.20	5.6-7.3	<2	High------	0.43			
	38-60	25-38	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Moderate	0.43			
HdC2, HdD2------- Hastings	0-7	28-35	1.20-1.40	0.6-2.0	0.21-0.23	5.6-6.5	<2	Moderate	0.32	5	7	.5-1
	7-23	35-42	1.30-1.40	0.2-0.6	0.11-0.20	5.6-7.3	<2	High------	0.43			
	23-60	25-38	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Moderate	0.43			
He, Hf----------- Hobbs	0-7	18-27	1.10-1.30	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low-------	0.32	5	6	2-4
	7-60	18-30	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low-------	0.32			
HgC, HgD--------- Holder	0-14	18-25	1.40-1.60	0.6-2.0	0.22-0.24	5.6-7.3	<2	Low-------	0.32	5	6	2-3
	14-26	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.43			
	26-60	18-30	1.40-1.60	0.6-2.0	0.20-0.22	6.6-8.4	<2	Moderate	0.43			
HhC2, HhD2------- Holder	0-7	28-35	1.30-1.50	0.6-2.0	0.21-0.23	5.6-7.3	<2	Moderate	0.32	5	7	.5-1
	7-17	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.43			
	17-60	18-30	1.40-1.60	0.6-2.0	0.20-0.22	6.6-8.4	<2	Moderate	0.43			
Hr, HrB---------- Hord	0-16	17-27	1.30-1.40	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low-------	0.32	5	6	2-4
	16-48	20-35	1.35-1.45	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low-------	0.32			
	48-60	18-30	1.30-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-------	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
Ma---------------- Massie	0-9	15-40	1.40-1.50	0.2-2.0	0.21-0.24	5.1-6.5	<2	Moderate	0.37	5	6	4-7
	9-60	40-55	1.20-1.50	<0.06	0.09-0.13	5.6-7.8	<2	High------	0.37			
MdF-------------- Meadin	0-7	5-10	1.50-1.60	0.6-2.0	0.13-0.18	5.1-7.3	<2	Low--------	0.20	3	3	1-2
	7-60	0-3	1.50-1.70	>20	0.02-0.05	6.1-7.3	<2	Low--------	0.10			
Pt*. Pits												
Sc---------------- Scott	0-7	15-35	1.30-1.40	0.6-2.0	0.22-0.24	5.6-7.3	<2	Low--------	0.37	4	6	2-4
	7-42	38-55	1.30-1.50	<0.06	0.10-0.20	5.6-7.8	<2	High------	0.37			
	42-55	32-40	1.10-1.40	0.2-0.6	0.18-0.20	6.6-7.8	<2	High------	0.37			
	55-60	18-40	1.30-1.50	0.6-2.0	0.14-0.22	6.6-7.8	<2	Moderate	0.37			
UyE2------------- Uly	0-5	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.32	5	6	.5-1
	5-14	20-32	1.20-1.30	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.43			
	14-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
UyF*:												
Uly--------------	0-8	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.32	5	6	1-2
	8-23	20-32	1.20-1.30	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.43			
	23-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
Hobbs------------	0-7	15-30	1.10-1.30	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low--------	0.32	5	6	2-4
	7-60	15-30	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.32			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the text explain terms such as "rare," "brief," "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth		Uncoated steel	Concrete
					Ft			In			
Bu: Butler	D	None	---	---	0.5-3.0	Perched	Mar-Jul	>60	High	High	Low.
Ca, Cd: Cass	B	Occasional	Brief	Mar-Jun	>6.0	---	---	>60	Moderate	Moderate	Low.
Ce, CeB, Cg: Crete	D	None	---	---	>6.0	---	---	>60	Moderate	Moderate	Low.
Fm: Fillmore	D	None	---	---	+.5-1.0	Perched	Mar-Jul	>60	High	High	Low.
Fo: Fillmore	D	None	---	---	1.0-3.0	Perched	Mar-Jul	>60	High	High	Low.
GaC, GaD: Geary	B	None	---	---	>6.0	---	---	>60	High	Low	Low.
GaF*:											
Geary	B	None	---	---	>6.0	---	---	>60	High	Low	Low.
Hobbs	B	Occasional	Brief	Apr-Sep	>6.0	---	---	>60	Moderate	Low	Low.
GeC2, GeD2, GeE2: Geary	B	None	---	---	>6.0	---	---	>60	High	Low	Low.
Ha: Hall	B	None	---	---	>6.0	---	---	>60	Moderate	Moderate	Low.
Hc, HcB, HcC, HdC2, HdD2: Hastings	B	None	---	---	>6.0	---	---	>60	Moderate	Moderate	Low.
He: Hobbs	B	Occasional	Brief	Apr-Sep	>6.0	---	---	>60	Moderate	Low	Low.
Hf: Hobbs	B	Frequent	Brief	Apr-Sep	>6.0	---	---	>60	Moderate	Low	Low.
HgC, HgD, HhC2, HhD2: Holder	B	None	---	---	>6.0	---	---	>60	High	Low	Low.
Hr, HrB: Hord	B	Rare	---	---	>6.0	---	---	>60	Moderate	High	Low.
Ma: Massie	D	None	---	---	+2-1.0	Perched	Mar-Aug	>60	High	High	Low.
MdF: Meadin	A	None	---	---	>6.0	---	---	>60	Low	Low	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth		Uncoated steel	Concrete
					Ft			In			
Pt*. Pits											
Sc----------------- Scott	D	None---------	---	---	+.5-1.0	Perched	Mar-Aug	>60	High---------	High------	Low.
UyE2--------------- Uly	B	None---------	---	---	>6.0	---	---	>60	Moderate-----	High------	Low.
UyF*:											
Uly---------------	B	None---------	---	---	>6.0	---	---	>60	Moderate-----	High------	Low.
Hobbs-------------	B	Occasional	Brief------	Apr-Sep	>6.0	---	---	>60	Moderate-----	Low-------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--ENGINEERING INDEX TEST DATA

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution: Percentage passing sieve--				Grain size distribution: Percentage smaller than--			Liquid limit	Plasticity index	Moisture density
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm			
										Pct		G/cm^3
Crete silt loam: (S76NE-035-002)												
Ap--------0 to 6	A-4 (08)	ML	100	100	100	99	92	24	19	32	6	2.58
B21t-----13 to 22	A-7-6(29)	CH	100	100	100	99	94	58	53	73	45	2.66
C--------32 to 60	A-6 (10)	CL	100	100	100	99	92	24	18	38	14	2.64
Fillmore silt loam: (S76NE-035-029)												
A1--------0 to 9	A-4 (08)	ML	100	100	100	99	90	24	18	37	7	2.53
B21t-----13 to 24	A-7-6(18)	CL-CH	100	100	100	99	97	50	43	50	29	2.67
C--------44 to 60	A-7-6(12)	CL	100	100	100	99	94	41	32	41	20	2.65
Hastings silt loam: (S76NE-035-034)												
Ap--------0 to 6	A-4 (08)	ML	100	100	100	99	92	26	22	34	9	2.56
B21t-----15 to 22	A-7-6(18)	CH	100	100	100	99	96	46	42	54	28	2.69
C--------38 to 60	A-7-6(12)	CL	100	100	100	99	92	32	25	42	18	2.66
Hobbs silt loam: (S74NE-035-008)												
Ap--------0 to 7	A-6 (10)	CL	100	100	100	96	91	30	24	40	15	2.61
C2-------23 to 37	A-6 (10)	CL	100	100	100	96	88	28	24	38	14	2.60
C4-------54 to 60	A-4 (08)	ML	100	100	100	95	85	19	17	30	5	2.65
Holder silt loam: (S75NE-035-019)												
A11-------0 to 5	A-7-6(11)	ML	100	100	100	98	91	26	21	42	16	2.57
B2t------14 to 26	A-7-6(14)	CL	100	100	100	100	96	36	29	46	22	2.67
C2-------38 to 60	A-6 (09)	CL	100	100	100	99	92	27	21	37	13	2.65
Hord silt loam: (S74NE-035-007)												
Ap--------0 to 8	A-4 (08)	ML	100	100	100	89	78	23	18	31	7	2.59
B2-------16 to 30	A-7-6(11)	CL	100	100	100	97	92	30	25	41	18	2.60
C--------55 to 60	A-4 (08)	ML	100	100	100	97	89	23	20	34	10	2.62
Massie clay: (S76NE-035-026)												
A11-------0 to 3	A-7-5(20)	MH	100	100	100	99	97	67	58	63	28	2.54
B22t-----25 to 65	A-7-6(24)	CH	100	100	100	100	99	51	45	61	40	2.67
C--------85 to 96	A-7-6(22)	CH	100	100	100	99	97	53	46	58	35	2.67
Scott silt loam: (S77NE-035-001)												
A1--------0 to 5	A-5 (09)	ML	100	100	99	98	93	28	22	45	10	2.50
B22t-----22 to 42	A-7-6(18)	CL-CH	100	100	100	99	94	47	42	50	30	2.66
C--------55 to 60	A-7-6(15)	CL	100	100	100	100	94	43	35	48	24	2.68

TABLE 19.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Butler	Fine, montmorillonitic, mesic Abruptic Argiaquolls
Cass	Coarse-loamy, mixed, mesic Fluventic Haplustolls
Crete	Fine, montmorillonitic, mesic Pachic Argiustolls
Fillmore	Fine, montmorillonitic, mesic Typic Argialbolls
Geary	Fine-silty, mixed, mesic Udic Argiustolls
Hall	Fine-silty, mixed, mesic Pachic Argiustolls
Hastings	Fine, montmorillonitic, mesic Udic Argiustolls
Hobbs	Fine-silty, mixed, nonacid, mesic Mollic Ustifluvents
Holder	Fine-silty, mixed, mesic Udic Argiustolls
Hord	Fine-silty, mixed, mesic Cumulic Haplustolls
Massie	Fine, montmorillonitic, mesic Typic Argialbolls
Meadin	Sandy-skeletal, mixed, mesic Entic Haplustolls
Scott	Fine, montmorillonitic, mesic Typic Argialbolls
Uly	Fine-silty, mixed, mesic Typic Haplustolls

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